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PELAGIC FUR SEAL INVESTIGATIONS, ALASKA, 1963

by Clifford H. Fiscus, Gary A. Baines, and Hiroshi Kajimura

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UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE

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BUREAU OF COMMERCIAL FISHERIES, Donald L. McKernan, *Director*

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CONTENTS

	Page
Introduction	1
Methods, equipment, and personnel	1
Methods and equipment	1
Personnel	2
Research in 1963	2
Distribution of Seals by time, place, and numbers	2
Distribution by time	2
Distribution by area	3
Numbers	3
Distribution by age and sex	5
Pairing at sea	7
Tag recoveries	7
Size and reproductive condition	7
Size	7
Pregnancy rate	8
Reproductive condition	9
Fetal sex ratio and uterine horn of pregnancy	12
Anomalies	12
Food habits	12
Individual food items	13
Relation of fur seals to commercial fisheries	16
Summary	17
Literature cited	18
Appendix A	19
Tables	19
Figures	30

TABLES

1.	Grouping of seals sighted during pelagic sealing research, 1958-63	5
2.	Age and sex by month of fur seals collected by U.S. research vessels in Bering Sea in 1963	6
3.	Male and female seals collected at sea	7
4.	Pelagic tag recovery rates, 1958-63	8
5.	Tag recoveries from fur seals collected by U.S. research vessels in Bering Sea in 1963	8
6.	Pregnancy rate of seals collected by U.S. research vessels in eastern Pacific, 1958-63	10
7.	Reproductive condition by month of female fur seals collected by U.S. research vessels in Bering Sea in 1963	11
8.	Fetal sex ratios and uterine horn of pregnancy 1958-63	12
9.	Stomach contents of fur seals from Bering Sea, 1 July to 5 September 1963	14

FIGURES

1.	Approximate course sailed by the chartered vessels, M/V Tacoma and M/V Harmony, 20-28 June 1963, from the Strait of Juan de Fuca to Unimak Pass. The daylight run when observations were made and the number of seals sighted each day is shown	2
2.	Eastern Bering Sea: The operational area of U.S. research vessels is shaded. The numbers in each zone represent, from left to right, number of boat days, seals seen, and seals collected from 1 July to 5 September 1963	4
3.	Comparison of lengths by age of 4,074 pregnant, 2,353 nonpregnant, and 1,528 post partum female fur seals collected by U.S. research vessels in eastern Pacific, 1958-63	9
4.	Lengths of 4,037 fur seal fetuses plotted by 10-day periods, U.S. research vessel collections in eastern Pacific, 1958-63	9
5.	Weights of 4,049 fur seal fetuses plotted by 10-day periods, U.S. research vessel collections in eastern Pacific, 1958-63	9

Page

6. The percent of stomachs containing food in relation to the time of collection, 1963. . . 13
7. Percent of stomach content volume and percent of occurrence in stomachs of the principal food species found in 1963 15

Appendix A tables:
1. Number and relative abundance of seals seen in Bering Sea, by 10-day periods, 1 July to 5 September 1963. 19
2. Number and relative abundance of seals collected in Bering Sea, by 10-day periods, 1 July to 5 September 1963 19
3. Number and relative abundance of seals seen and collected 1958-63 20
4. Grouping of 5,790 seals sighted in Bering Sea, 1 July to 5 September 1963 20
5. Total seals sighted, collected, wounded and lost, and killed and lost, 1958-63 20
6. Number and percent of seals shot at sea that were collected, wounded and lost, or killed and lost, 1958-63 21
7. Monthly mean lengths of pregnant fur seals collected by U.S. research vessels in Bering Sea in 1963. 21
8. Monthly mean weights of pregnant fur seals collected by U.S. research vessels in Bering Sea in 1963. 21
9. Monthly mean lengths of post partum fur seals collected by U.S. research vessels in Bering Sea in 1963. 22
10. Monthly mean weights of post partum fur seals collected by U.S. research vessels in Bering Sea in 1963. 23
11. Monthly mean lengths of nonpregnant fur seals collected by U.S. research vessels in Bering Sea in 1963. 24
12. Monthly mean weights of nonpregnant fur seals collected by U.S. research vessels in Bering Sea in 1963. 25
13. Monthly mean lengths of male fur seals collected by U.S. research vessels in Bering Sea in 1963. 26
14. Monthly mean weights of male fur seals collected by U.S. research vessels in Bering Sea in 1963. 27
15. Mean lengths of fur seal fetuses collected by U.S. research vessels in eastern Pacific, 1958-63. 28
16. Mean weights of fur seal fetuses collected by U.S. research vessels in eastern Pacific, 1958-63. 29

Appendix A figures:
1. Locations where fur seal stomachs collected in 1963 contained Clupea harengus pallasi, Bathylagidae, and Ammodytes hexapterus. The 100-fathom depth curve is shown as a dotted line 30
2. Locations where fur seal stomachs collected in 1963 contained Oncorhynchus sp., Theragra chalcogrammus, Gadidae, and Pleurogrammus monopterygius. The 100-fathom depth curve is shown as a dotted line 31
3. Locations where fur seal stomachs collected in 1963 contained Mallotus villosus. The 100-fathom depth curve is shown as a dotted line 32
4. Locations where fur seal stomachs collected in 1963 contained Myctophidae, Trichodontidae, and Gonatus magister. The 100-fathom depth curve is shown as a dotted line. 33
5. Locations where fur seal stomachs collected in 1963 contained Sebastodes sp., Pleuronectidae, Reinhardtius hippoglossoides, and Gonatus fabricii. The 100-fathom depth curve is shown as a dotted line 34
6. Locations where fur seal stomachs collected in 1963 contained Gonatopsis sp. The 100-fathom depth curve is shown as a dotted line 35
7. On calm days sleeping fur seals can be plainly seen for a considerable distance. With flippers folded they look like a drifting piece of dark wood 36
8. When moving rapidly seals often leap out of the water. This behavior is most typical of young animals and is unusual for mature bulls or females in late pregnancy. . . . 36

Pelagic Fur Seal Investigations
Alaska, 1963

by

Clifford H. Fiscus, Gary A. Baines,
Hiroshi Kajimura

ABSTRACT

The sixth year of pelagic fur seal research under the terms of the Interim Convention on Conservation of North Pacific Fur Seals was conducted in the Bering Sea from July to September 1963. Seals were found scattered through the area between the Strait of Juan de Fuca and Unimak Pass, but most were seen within 75 to 100 miles of land. Much of the collection was made north of Unalaska Island. The principal movement of seals in the Bering Sea in late summer and early fall is between the Pribilof Islands and the feeding grounds. Most animals appeared to travel from 60 to 90 miles offshore from the islands to feed. Groups of one to three seals accounted for 90.3 percent of all seals seen in 1963. Of 1,355 seals collected in 1963, 111 were males and 1,244 females. Post partum females were predominant in the collection. The first adult males that appeared to have held harems in 1963 were seen on 31 July near Akun Island. Most of 25 males accompanying females were observed within 20 miles of the Pribilof Islands. Of 43 tagged seals collected in 1963, 8 were males and 35 females. Mean lengths of nonpregnant, pregnant, and post partum females were compared. Pregnant females were longer than nonpregnant or post partum females. Females in ages 8 through 13 had the highest pregnancy rates. The youngest pregnant females collected were 4 years old. The fish and cephalopods eaten ranged from 5 to 45 cm. in length. Small prey usually are eaten below the sea surface, and larger prey brought to the sea surface and swallowed in chunks. Surface water temperature appears to have no direct effect on distribution. Fur seals are primarily night and early morning feeders. Squids were the major food in 1963 in the Bering Sea, followed by capelin, walleye pollock, and deepsea smelt. A deepsea smelt, the Greenland halibut, and a lanternfish were found for the first time in fur seal stomachs. Salmon were found in 14 fur seal stomachs, herring in 15, and walleye pollock in 47. These three species are fished commercially in the Bering Sea.

INTRODUCTION

This report furnishes information on the sixth year of pelagic research on fur seals conducted by the United States as specified by the Interim Convention on Conservation of North Pacific Fur Seals.

From 1958 to 1961, investigations were made of fur seals from the southern to the northern limits of their range. In 1962, an intensive study was concentrated in Unimak Pass and vicinity. Operations in 1963 were confined to the Bering Sea, where investigations of distribution, abundance, and food habits of fur seals on their summer range were carried out from 1 July to 5 September. Behavior, feeding patterns, and reproductive condition of females were also studied.

To observe the distribution and movement of fur seals in the North Pacific during their spring migration, the research vessels sailed directly to Unimak Pass from the Strait of Juan de Fuca.

Note.--Clifford H. Fiscus, Wildlife Biologist (Research), Gary A. Baines, Wildlife Biologist (General), and Hiroshi Kajimura, Fisheries Biologist (Research), Bureau of Commercial Fisheries Marine Mammal Biological Laboratory, U.S. Fish and Wildlife Service, Seattle, Wash.

METHODS, EQUIPMENT, AND PERSONNEL

Methods and Equipment

Vessel and boat requirements and operations described in the 1962 report (Fiscus, Baines, and Wilke, 1964) were duplicated in 1963. Two purse seine vessels, the M/V Harmony[1]

[1] M/V Harmony: registered length 70.5 feet, 61 net tons, 220 horsepower, cruising speed 9 knots.

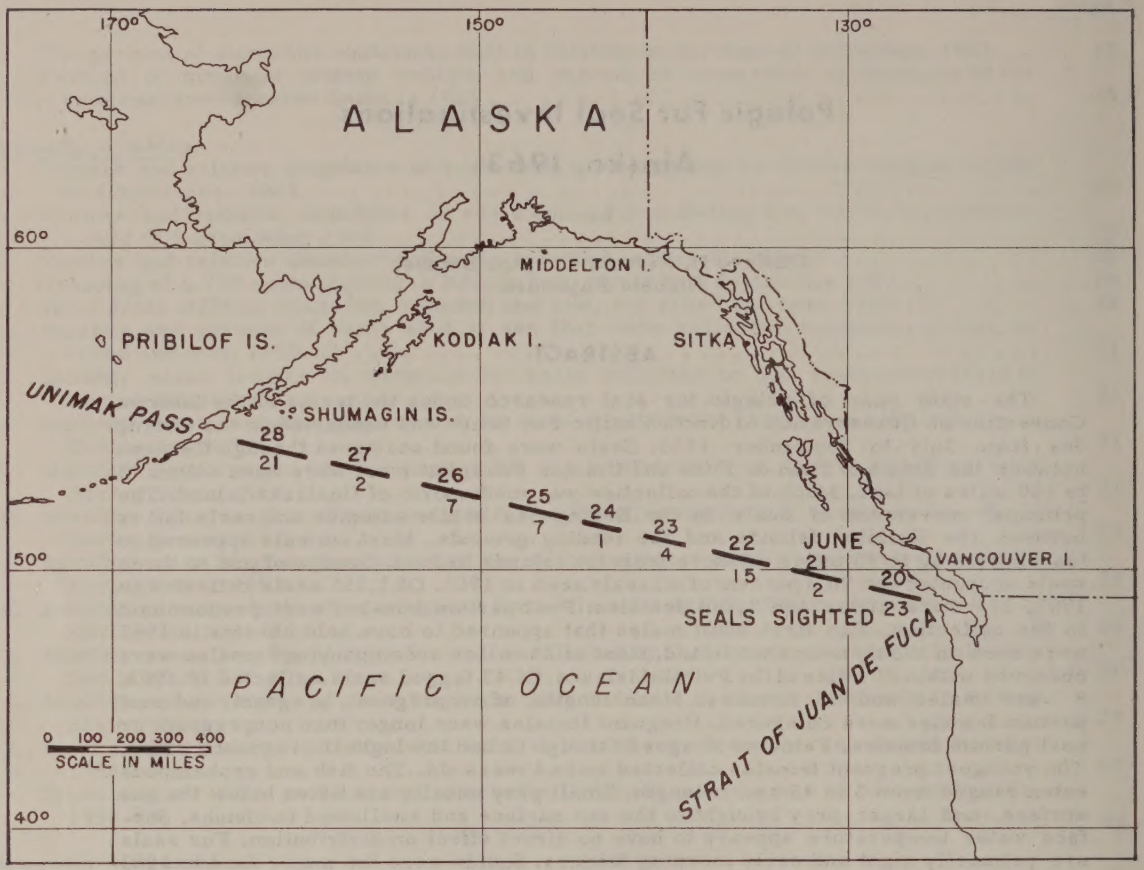


Figure 1.--Approximate course sailed by the chartered vessels, M/V Tacoma and M/V Harmony, 20-28 June 1963, from the Strait of Juan de Fuca to Unimak Pass. The daylight run when observations were made and the number of seals sighted each day is shown.

and the M/V Tacoma,[2] were used. The vessels sailed together from the Strait of Juan de Fuca directly to Unimak Pass during 20-28 June, worked in the Bering Sea from 1 July to 5 September, and returned to Seattle via Kodiak, Sitka, and the inside passage through southeast Alaska in September.

Hunting methods, field examination of fur seals, laboratory methods used in preparing and determining the ages of fur seal teeth, and analysis and identification of stomach contents were not changed from those described by Fiscus, Baines, and Wilke (1964).

Personnel

Clifford H. Fiscus and Gary A. Baines took part in all aspects of pelagic fur seal investigations in 1963. Hiroshi Kajimura assisted with work in the laboratory.

Temporary employees included Rex Thomas, Ted H. Hodgson, Leslie M. Kemp, Stanley B. Phillips, George F. Rohrmann, and Alexis R. Verhoogen.

RESEARCH IN 1963

Distribution of Seals by Time, Place, and Numbers

Distribution by time.--The vessels sailed parallel courses to Unimak Pass, usually keeping within 2 miles of each other. Seal watches were maintained during daylight, and all seal sightings were recorded. Figure 1 shows the daily run of the vessels and the number of seals seen.

[2] M/V Tacoma: registered length 71.5 feet, 76 net tons, 240 horsepower, cruising speed 9 knots.

The crossing in June was the first made in that month by biologists concentrating on fur seal observations. Of 82 seals sighted, 44 were seen during the first and last days when the vessels were within 75 to 100 miles of land. Offshore distribution of seals appeared uneven; however, weather conditions, which varied considerably, had a direct bearing on the number of seals sighted.

Kenyon and Wilke (1953) indicated that the fur seal is widely scattered in the eastern North Pacific in June. Pike, Spalding, MacAskie, and Craig[3] state that "seals are numerous and widely dispersed throughout the eastern North Pacific during the months of April, May, June, and July." Their report is based on sightings by biologists aboard Canadian salmon research vessels, in the area north of lat. 45° N. and east of long. 160° W. The results of June 1963 observations in the same area confirm and supplement their data.

The northward movement of large numbers of fur seals in the late spring and early summer along the coast past Vancouver Island and Sitka, and westward past Middleton Island, Kodiak, the Shumagin Islands, and into the Bering Sea is well known and has been described by Kenyon and Wilke (1953) and by Townsend (1899).

The movement of fur seals in the offshore areas of the eastern North Pacific is not as well understood. Further investigations may show that much of the eastern North Pacific fur seal herd will be found far from land during the northward migration. Available information is not adequate to show whether the number of animals in offshore areas varies from year to year according to the abundance of food species and other ocean conditions.

Distribution by area.--A study of the distribution, abundance, and food habits of fur seals on their summer range in the Bering Sea was carried out from 1 July to 5 September 1963. To aid in the analysis of data, the eastern Bering Sea (fig. 2) was divided into six major sectors centered between St. Paul and St. George Islands. The sectors were then divided into zones, each 30 nautical miles wide and extending to the sector boundaries. Sectors are numbered from 1 to 6, zones from 1 to 9. Sector and zone numbers are used in combinations, as, for example: 1-7. The first number represents the sector, the second, the zone. The shaded portion of figure 2 represents the area actually surveyed in 1963. The numbers in each zone give, from left to right, (1) the number of boat-hunting days[4] (spent in the zone), (2) the total number of seals seen (in the zone), and (3) the total number of seals collected (in the zone).

Because the sectors in zone 1 were small, they were consolidated; the numbers shown represent all effort in zone 1 regardless of sector. More hunting was done in sector 1, zones 4 to 8, than in other areas (fig. 2), because of various reasons. (1) The vessels had to return from the Pribilof locality to Dutch Harbor, Unalaska Island, for fuel and water at monthly intervals. On these trips, routine hunting procedures were followed. (2) The sea immediately north of the eastern Aleutians (Fox Island group) in zone 7 is an important feeding ground for fur seals. Periodic surveys begun in this locality in 1962 were continued in 1963. (3) Convention obligations required the United States to collect a specified number of seals at sea each year. To fulfill this obligation, a large sample was collected in 1-7.

Based on collecting effort, distribution of seals in the first three zones of sectors 1 through 6 appear uniform. Concentrations of seals were located in 1-4, 4-4, and 5-4. Except in sector 1, relatively little time was spent in the outer zones. A study of the distribution of seals in the outer zones is planned for 1964. Fewer fur seals were found to frequent sector-zone 1-7 in 1963 than in 1962, and the most heavily used feeding locality had shifted from north of Akun Island and Unimak Pass in 1962 to north of Cape Cheerful, Unalaska Island in 1963.

Generally, the principal movement of seals in the Bering Sea during late summer and early fall is between the Pribilof Islands and the feeding grounds. The seals found within a few miles of the islands display two general types of behavior. Some rest while others travel rapidly in the same general direction. If disturbed, resting seals usually do not travel far before resuming rest. Traveling seals, if distracted, may change direction, but usually resume their original course after the danger is past. Seals behaving in this manner presumably are traveling to or returning from feeding areas.

Most animals appeared to travel into zone 3 and beyond before they did any appreciable amount of feeding. In 1962 and 1963, many feeding seals were found in sector-zone 1-7. In 1962, a few seals had passed through Unimak Pass and into sector-zone 1-9 to feed. Feeding areas were located in almost all directions from the Pribilof Islands in 1963. Seals in these areas may be feeding or resting. Feeding areas shift in location from year to year with variation in abundance of food species.

Numbers.--The number and relative abundance of seals seen and collected is shown by 10-day periods in appendix A, tables 1 and 2. Variation between 10-day periods in numbers

[3] G. C. Pike, D. J. Spalding, I. B. MacAskie, and A. Craig. Report on Canadian pelagic fur seal research in 1962. Fisheries Research Board of Canada, Biological Station, Nanaimo, B. C. (Manuscript report.)

[4] A boat-hunting day is a day in which a vessel is used to collect or observe seals for 8 hours or more; units of boat-hunting days are 0.25, 0.50, 0.75, and 1.00.

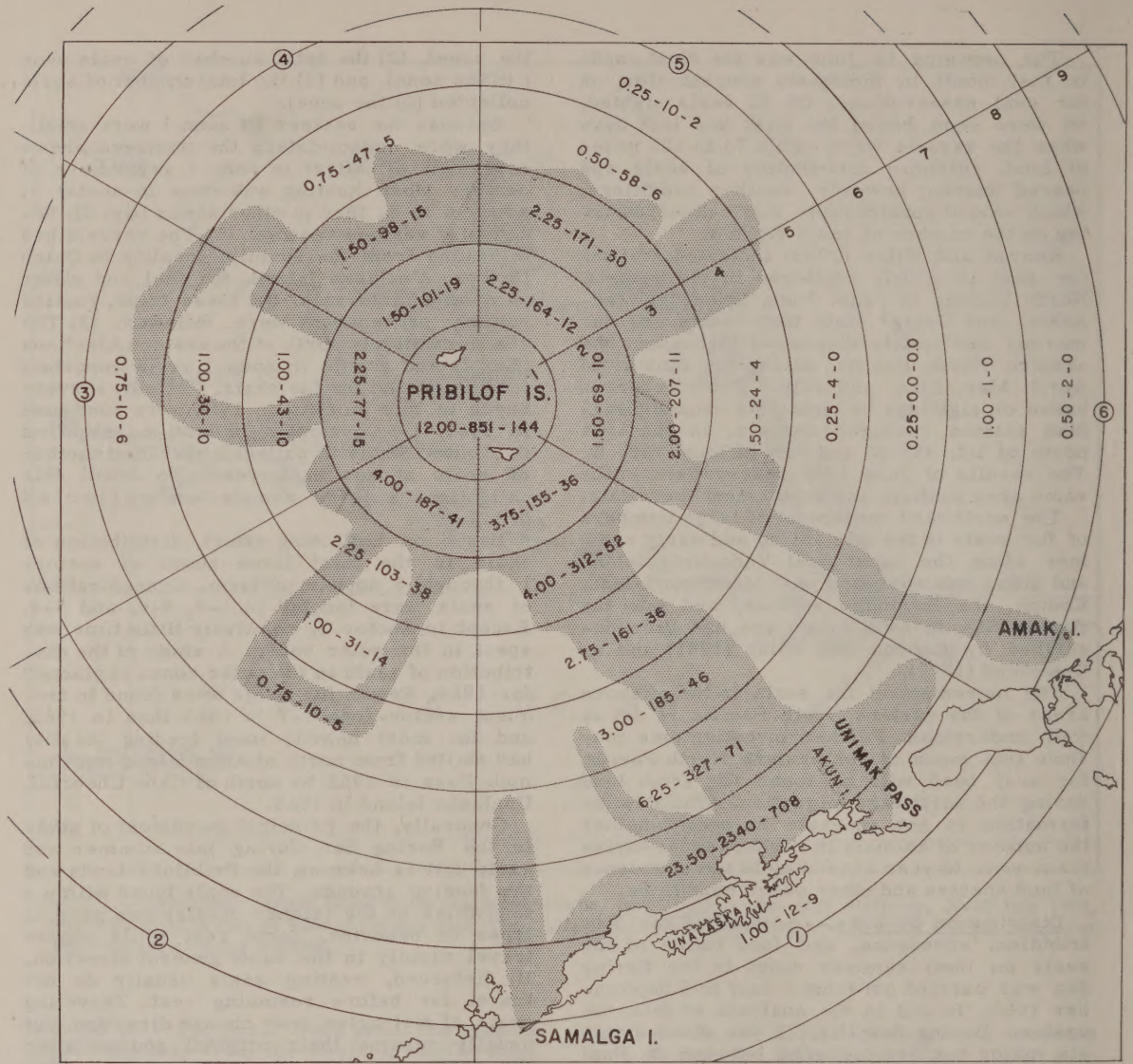


Figure 2.--Eastern Bering Sea: The operational area of U.S. research vessels is shaded. The numbers in each zone represent, from left to right, number of boat days, seals seen, and seals collected from 1 July to 5 September 1963.

of seals seen and collected was caused by changes in the weather and in the locality where collections were made rather than by a sudden rise or decline in the numbers of seals in the Bering Sea. Table 3 in appendix A shows the number and relative abundance of seals seen and collected from 1958 to 1963. The average number of seals seen per boat day was higher in years when work was done entirely in Alaskan waters, particularly in 1962 and 1963 when almost all observations were made in the Bering Sea.

One or more seals traveling, feeding, or resting together were classified as a group. For convenience, a single seal was recorded as a group of one. Table 4 in appendix A lists the group size of seals sighted in 1963. Table 1 combines 6 years of observations on group size. Groups of one, two, and three seals accounted for 70 percent or more of all seals sighted. In 1962 and 1963, when research was carried out almost entirely in the Bering Sea, groups of three or less made up 88.5 percent and 90.3 percent of the total sightings.

Obviously, the fur seal seldom is found at sea in large groups or massed herds. In areas where fur seals abound, many small groups may be seen at one time. Most large groups

Table 1.--Grouping of seals sighted during pelagic sealing research, 1958-63

Year	Area of operation	Total seals sighted per year	Group size										
			1	2	3	4	5	6	7	8	9	10	10+
			Percent sighted per group size										
1958	California to Alaska	[1] 5,947	32.1	27.7	17.4	10.0	5.8	2.5	2.3	1.1	0.9	0.2	-
1959	California to Washington	5,919	34.6	19.9	12.6	7.2	4.0	3.7	1.7	2.0	.5	1.9	11.9
1960	Alaska	6,287	35.2	23.7	13.5	7.7	4.2	4.5	1.0	2.0	.1	1.3	6.8
1961	California to British Columbia	3,415	34.9	27.4	14.9	8.1	6.3	1.9	1.6	2.1	-	.6	2.2
1962	Alaska	6,111	43.7	30.4	14.4	5.2	2.9	1.4	.3	.4	.3	.2	.8
1963	Alaska	5,790	49.0	28.1	13.2	5.8	2.2	.5	.2	.3	.2	.2	.3
1958-63		33,469	38.4	26.1	14.3	7.3	4.1	2.5	1.2	1.3	.3	.7	3.8

[1] Does not include 1,077 seals sighted but grouping not recorded.

observed were found in or near schools of food species, and they dispersed after feeding. Data collected in 1962 and 1963 indicate that the fur seal is more solitary on its summer range in the Bering Sea than on other parts of its ocean range.

Appendix tables 5 and 6 summarize the records of seals sighted, collected, wounded and lost, and killed and lost for 1958 through 1963.

Distribution by Age and Sex

Of 1,355 seals collected in 1963, 111 (8.2 percent) were males and 1,244 (91.8 percent) females. Thirteen females of indeterminable age were classified in the tables as unknown.

Table 2 gives the age and sex of seals collected in 1963. Five-year-old females from the 1958 year class predominated in collection of females. The strength of the 1958 year class was also noted in former pelagic collections (Fiscus, Baines, and Wilke, 1964) and in the harvest of fur seals on the Pribilof Islands in 1962 (Roppel, Johnson, Bauer, Chapman, and Wilke, 1963). Nearly one-third of the males collected in 1963 were 2-year-olds.

The relative distribution of male and female seals was fairly uniform in the Bering Sea in 1963 except in three sectors. In early July, 8 of 22 seals collected 140-186 miles south of St. George Island (sector-zone 1-6 and 1-7) were males 1 to 5 years old. In an area 90-120 miles southwest of St. George Island (sector-zone 2-4 and 2-5), 4 of 10 seals collected in mid-July were males 3 to 5 years old. The area in which the seals were collected suggested movement of young male seals from Asian waters to the Pribilof Islands.

Post partum females predominated among seals collected in early July (sectors 1 and 2, zones 3 and 4) within 90 miles of the islands (fig. 2). From mid-July to early September, post partum females also predominated in feeding areas of the outer zones (zones 4-7).

From late July through most of August, a high incidence of young males in collections made 30-40 miles southwest of St. George Island (sector-zone 2-2) suggested an influx of late arriving young males from the western Pacific.

The first adult males found away from the Pribilof Islands were seen 31 July from 5 to 20 miles northwest of Billings Head, Akun Island (sector-zone 1-7). Of seven observed, two thin animals 8 and 12 years old were collected. The condition of these seals indicated that they had held harems on the Pribilof Islands during the breeding season. Five more adult males were seen off Cape Cheerful, Unalaska Island, (sector-zone 1-7) 1-8 August. A thin 12-year-old collected also probably had been a breeding male. In mid-August, seven adult males were

Table 2.--Age and sex by month of fur seals collected by U.S. research vessels in Bering Sea in 1963

Age	July				August				September				Combined					
	Males		Females		Males		Females		Males		Females		Males		Females		Males and Females	
Years	No.	Percent	No.	Percent	No.	Percent	No.	Percent	No.	Percent	No.	Percent	No.	Percent	No.	Percent	No.	Percent
1	1	1.8	1	0.3	2	3.9	-	-	1	25.0	-	-	4	3.6	1	0.1	5	0.4
2	6	10.7	3	.8	26	51.0	17	2.0	2	50.0	1	4.0	34	30.7	21	1.7	55	4.1
3	18	32.0	7	1.9	7	13.7	44	5.2	1	25.0	2	8.0	26	23.4	53	4.3	79	5.8
4	10	17.9	32	8.6	4	7.8	80	9.4	-	-	1	4.0	14	12.6	113	9.1	127	9.4
5	11	19.6	56	15.1	4	7.8	102	12.0	-	-	4	16.0	15	13.5	162	13.0	177	13.1
6	2	3.6	28	7.5	-	-	60	7.1	-	-	2	8.0	2	1.8	90	7.2	92	6.8
7	3	5.4	29	7.8	1	2.0	44	5.2	-	-	4	16.0	4	3.6	77	6.2	81	6.0
8	2	3.6	31	8.3	3	5.9	54	6.4	-	-	2	8.0	5	4.5	87	7.0	92	6.8
9	1	1.8	21	5.6	1	2.0	38	4.5	-	-	1	4.0	2	1.8	60	4.8	62	4.6
10	-	-	16	4.3	-	-	53	6.2	-	-	3	12.0	-	-	72	5.8	72	5.3
11	-	-	23	6.2	1	2.0	64	7.6	-	-	1	4.0	1	.9	88	7.1	89	6.6
12	1	1.8	28	7.5	1	2.0	63	7.4	-	-	1	4.0	2	1.8	92	7.4	94	6.9
13	-	-	31	8.3	-	-	44	5.2	-	-	1	4.0	-	-	76	6.1	76	5.6
14	-	-	17	4.6	1	2.0	40	4.7	-	-	-	-	1	.9	57	4.6	58	4.3
15	1	1.8	22	5.9	-	-	51	6.0	-	-	2	8.0	1	.9	75	6.0	76	5.6
16	-	-	14	3.8	-	-	31	3.7	-	-	-	-	-	-	45	3.6	45	3.3
17	-	-	5	1.3	-	-	23	2.7	-	-	-	-	-	-	28	2.3	28	2.1
18	-	-	3	.8	-	-	9	1.1	-	-	-	-	-	-	12	1.0	12	.9
19	-	-	1	.3	-	-	4	.5	-	-	-	-	-	-	5	.4	5	.3
20	-	-	2	.5	-	-	9	1.1	-	-	-	-	-	-	11	.9	11	.8
21	-	-	1	.3	-	-	3	.4	-	-	-	-	-	-	4	.3	4	.3
23	-	-	1	.3	-	-	1	.1	-	-	-	-	-	-	2	.1	2	.1
Unknown	-	-	-	-	-	-	13	1.5	-	-	-	-	-	-	13	.0	13	.9
Total	56	100.0	372	100.0	51	100.0	847	100.0	4	100.0	25	100.0	111	100.0	1,244	100.0	1,355	100.0

seen in Unimak Pass (sector-zone 1-8) north of Billings Head 17-18 August. Three thin animals 7 to 8 years old were collected. Adult males occasionally were seen in late August and early September within 40 miles of the Pribilofs.

During the 6-year period, fewer male seals were collected off California, Oregon, Washington, and British Columbia than off Alaska (table 3). The high proportion of males (11.2 percent) collected in 1958 is the result of collections made in the Gulf of Alaska. Of 897 seals taken off Alaska in 1958, 157 (17.5 percent) were males while only 11 (1.8 percent) of 606 seals collected off California, Oregon, and Washington were males.

Older males remain in northern waters from Cape Ommaney north and west across the Gulf of Alaska and south of the Alaska Peninsula in winter and spring, and in the Bering Sea during summer and fall. The females and young males winter from British Columbia south to California. Except for a sick 8-year-old taken off Washington in 1959, all males collected off California, Oregon, Washington, and British Columbia from 1958 through 1963 were 5 years old or younger.

Pairing at Sea

In 1963, special efforts were made to collect information on the pairing of males and females at sea. Of 25 pairs observed, 21 were seen within 50 miles of the Pribilof Islands; the majority were found less than 20 miles offshore.

Six of the males and 10 of the females were collected. The males were 5 to 15 years old, the females 4 to 15 years.

The fact that most of the males were reluctant to leave their females made collection of some of the males possible. The first pair was sighted 10 July, 45 miles southwest of St. George Island. The female was killed on the first shot and left in the water. Though the female was dead, the male would not leave her, but persisted in staying nearby until wounded and finally killed. Behavior of the male indicates that the pairing was not a coincidence and that the male was interested in mating.

Except for one 15-year-old, the males were 5-9 years old and weighed from 52 to 110 kg. Few males of these ages are found on the rookeries until after breakup of the harem structure in late July. Presumably, they are not yet capable of holding a harem. For this reason, many may attempt mating at sea. Because he weighed only 155 kg., the 15-year-old male also may have been unable to hold a harem.

Of the 10 females collected, 9 were post partum and 1 was nulliparous. Four of the post partum females had mature follicles in one ovary; six had a ruptured follicle or forming corpus luteum. The strong attraction of the males to the females is difficult to understand in view of the fact that six of the females had probably mated. Either there are females in estrus at sea or the observed behavior is an extension of that shown by young males toward females on land. Whether fur seals can successfully copulate in water is unknown.

In general, the females did not seem to belong to any particular category. Only one was in poor physical condition, and the others were a mixture of nulliparous, primiparous, and multiparous animals.

Tag Recoveries

The pelagic tag recovery rates for 1958-63 are compared in table 4.

Of 43 tagged seals collected in the Bering Sea in 1963, 8 were males and 35 females (table 5).

Size and Reproductive Condition

Size.--Lengths and weights of the seals collected are given in tables 5-14, appendix A. The fact that pregnant fur seals are slightly

Table 3.--Male and female seals collected at sea

Year	Area of collection	Males collected		Females collected		Total
		Number	Percent	Number	Percent	Number
1958	Calif., Oreg., Wash., Alaska	168	11.2	1,335	88.8	1,503
1959	Calif., Oreg., Wash.	37	2.4	1,511	97.6	1,548
1960	Alaska	171	11.4	1,324	88.6	1,495
1961	Calif., Oreg., Wash., B.C.	77	5.7	1,275	94.3	1,352
1962	Alaska	132	8.9	1,354	91.1	1,486
1963	Alaska	111	8.2	1,244	91.8	1,355
Total		696	8.0	8,043	92.0	8,739

Table 4.--Pelagic tag recovery rates, 1958-63

Year	Area	Seals collected		Tags recovered		Seals with tags		
		♂	♀	♂	♀	♂	♀	♂ and ♀
		No.	No.	No.	No.	Percent	Percent	Percent
1958	Calif., Oreg., Wash., Alaska	168	1,335	6	8	3.6	0.6	0.9
1959	Calif., Oreg., Wash.	37	1,511	1	18	2.7	1.2	1.2
1960	Alaska	171	1,324	7	18	4.1	1.4	1.7
1961	Calif., Oreg., Wash., B.C.	77	1,275	4	25	5.2	2.0	2.1
1962	Alaska	132	1,354	8	42	6.1	3.1	3.4
1963	Alaska	111	1,244	8	35	7.2	2.8	3.2

Table 5.--Tag recoveries from fur seals collected by U.S. research vessels in Bering Sea in 1963

Age	Year tag attached	Tag series	Seals tagged	Tags recovered		Catch per year class		
				♂	♀	♂	♀	♂ and ♀
Years			No.	No.	No.	No.	No.	No.
2	1961	N	49,921	5	1	34	21	55
3	1960	M	59,981	3	6	26	53	79
4	1959	L	49,881	-	6	14	113	127
5	1958	K	49,917	-	7	15	162	177
6	1957	J	49,842	-	3	2	90	92
7	1956	I	49,900	-	2	4	77	81
8	1955	[1] H	49,870	-	7	5	87	92
9	1954	G	10,000	-	1	2	60	62
11	1952	E	19,979	-	1	1	88	89
14	1949	CS	19,960	-	1	1	57	58
Total				8	35			

[1] Includes H numbers 1-10,000, no series letter numbers 10,001-50,000.

longer than nonpregnant fur seals of the same ages was first noted by Taylor, Fujinaga, and Wilke (1955). Differences, which are most noticeable in seals under 10 years of age, have been observed in the pelagic collections from 1958 through 1963. In early comparisons, post partum seals were included with pregnant seals. In 1962, however, the mean lengths of 548 post partum females were compared with the mean lengths of 282 pregnant and 513 nonpregnant females (Fiscus, Baines, and Wilke, 1964). The data showed that the lengths of post partum females agreed more closely with the lengths of nonpregnant females, rather than with the lengths of pregnant females as would be expected. In 1963, mean lengths of 4,074 pregnant, 1,528 post partum, and 2,353 nonpregnant females collected from 1958 through 1963 in eastern Pacific waters were compared (fig. 3). As in 1962, the lengths of nonpregnant and post partum seals agreed more closely than did the lengths of pregnant and post partum seals. Considering the sample size, it is doubtful that measurement errors could account for this result. For an unknown reason, pregnant females apparently decrease in length after parturition. We are not aware of physiological changes in mammals that would account for the increased lengths of the pregnant seals.

Tables 15 and 16, appendix A, give the mean lengths and weights of fetuses collected from 1958 through 1963. The average weight and length of fetuses by 10-day periods are plotted in figures 4 and 5. Information is lacking for November and December, an important period because it is the time when the blastocyst is implanted.

Pregnancy rate.--The pregnancy rates of female seals collected from 1958 through 1963 are shown in table 6. Approximately 36 percent of the 5-year-old primiparous females collected in 1963 were pregnant from con-

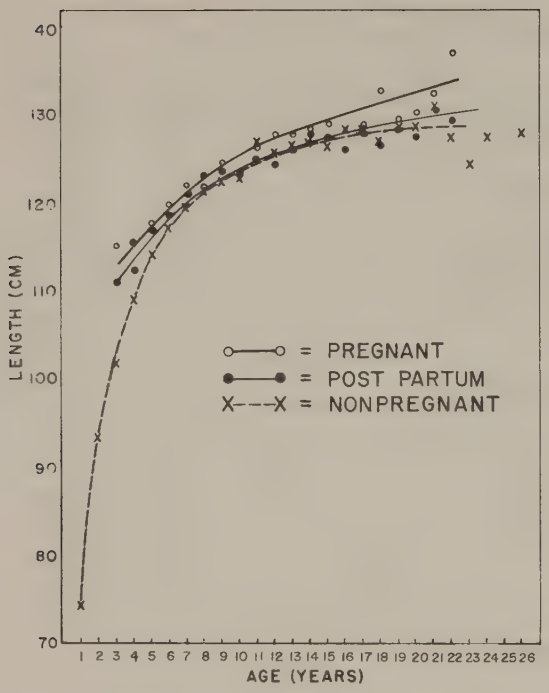


Figure 3.--Comparison of lengths by age of 4,074 pregnant, 2,353 nonpregnant, and 1,528 post partum female fur seals collected by U.S. research vessels in eastern Pacific, 1958-63.

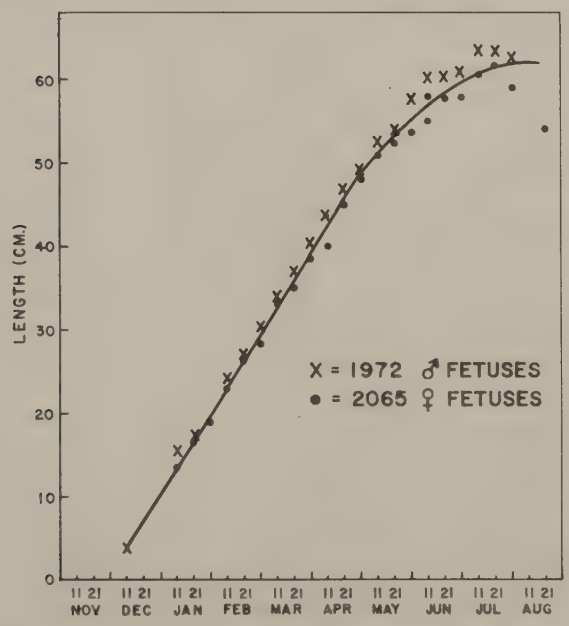


Figure 4.--Lengths of 4,037 fur seal fetuses plotted by 10-day periods, U.S. research vessel collections in eastern Pacific, 1958-63.

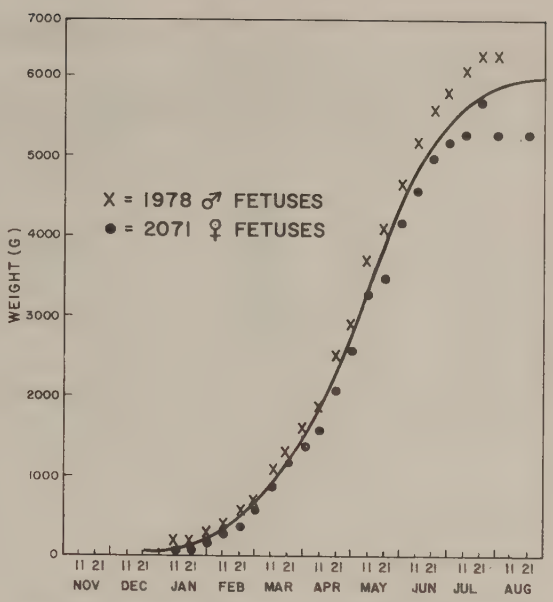


Figure 5.--Weights of 4,049 fur seal fetuses plotted by 10-day periods, U.S. research vessel collections in eastern Pacific, 1958-63.

ception at age 4 in 1962. Of 92 4-year-old nulliparous females, 25 had ovaries containing a ruptured follicle or a forming corpus luteum. These results support conclusions made previously that more females in the Pribilof herd reached sexual maturity at age 4 than at any other age. The pregnancy rate increases to 87.3 - 91.0 percent for the year classes 8 through 13, and gradually declines thereafter.

The average pregnancy rate of 84.1 percent for females 6 years and older is remarkably uniform for the 6 collection years. The rate decreased to 71.9 percent when 3-, 4-, and 5-year-old females are included.

Reproductive conditions.--The reproductive conditions of females collected in the Bering Sea are shown in table 7 by age and month.

Nulliparous, primiparous, and multiparous females were taken regularly throughout the season and uniformly over the collection area. A ruptured follicle or a developing corpus luteum was observed in the ovaries of 6 of 36 3-year-old nulliparous females collected. Five primiparous and three multiparous 4-year-olds were the youngest pregnant females taken. The latter three had apparently reached some stage of pregnancy at age 3.

Nonpregnant, multiparous females were collected consistently through July and August. The majority of them were 12 years old or older. The pattern of sexual maturity and pregnancy rates shown by data collected in

Table 6.--Pregnancy rate of seals collected by U.S. research vessels in eastern Pacific, 1958-63

Age	Number of females							Number pregnant							Percent pregnant						
	1958	1959	1960	1961	1962	1963	Combined	1958	1959	1960	1961	1962	1963	Combined	1958	1959	1960	1961	1962	1963	Combined
Years																					
3	39	43	18	84	93	53	330	1	-	-	-	1	-	2	2.6	-	-	-	1.1	-	0.7
4	42	93	36	96	140	113	520	1	6	1	1	4	8	21	2.4	6.4	2.8	1.0	2.9	7.1	4.0
5	70	114	55	68	123	162	592	32	64	27	14	32	71	240	45.7	56.1	49.1	20.6	26.0	43.8	40.5
6	99	118	45	62	72	90	486	80	91	36	47	39	67	360	80.8	77.1	80.0	75.8	54.2	74.4	74.1
7	103	143	66	95	93	77	577	92	109	52	72	79	68	472	89.3	76.2	78.8	75.8	84.9	88.3	81.8
8	102	164	105	107	98	87	663	91	142	90	85	88	85	581	89.2	86.6	85.7	79.4	89.8	97.7	87.6
9	81	108	144	114	73	60	580	78	96	133	107	61	51	526	96.3	88.9	92.4	93.9	83.6	85.0	90.7
10	97	96	129	112	100	72	606	85	82	118	105	89	67	546	87.6	85.4	91.5	93.8	89.0	93.1	90.1
11	113	98	136	82	91	88	608	104	88	124	73	81	83	553	92.0	89.8	91.2	89.0	89.0	94.3	91.0
12	134	76	106	71	97	92	576	110	67	96	66	87	85	511	82.0	88.2	90.6	93.0	89.7	92.4	88.7
13	110	56	120	76	58	76	496	91	50	105	63	55	69	433	82.7	89.3	87.5	82.9	94.8	90.8	87.3
14	92	70	107	67	65	57	458	75	59	86	62	57	46	385	81.5	84.3	80.4	92.5	87.7	80.7	79.4
15	71	87	67	68	53	75	421	56	77	56	54	43	64	350	78.9	88.5	83.6	79.4	81.1	85.3	82.9
16	56	69	53	55	50	45	328	44	52	38	47	41	37	259	78.6	75.4	71.7	85.5	82.0	82.2	79.0
17	36	36	46	24	44	28	214	20	29	31	15	32	20	147	55.6	80.6	67.4	62.5	72.7	71.4	68.7
18	22	27	23	25	25	12	134	13	23	19	16	18	7	96	59.1	85.2	82.6	64.0	72.0	58.3	71.6
19	14	16	19	10	15	5	79	4	13	11	5	9	3	45	28.6	81.3	57.9	50.0	60.0	60.0	57.0
20	3	5	6	7	11	11	43	1	2	1	7	8	5	24	33.3	40.0	16.7	100.0	72.7	45.5	55.8
21	1	7	6	2	3	4	23	1	6	3	1	3	2	16	100.0	85.7	50.0	50.0	100.0	50.0	69.6
22	1	5	-	-	3	-	9	-	2	-	-	2	-	4	-	40.0	-	-	66.7	-	44.4
23	-	1	1	1	-	2	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24	-	1	1	1	1	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26	-	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	1,286	1,434	1,289	1,227	1,308	1,209	7,753	979	1,058	1,027	840	829	838	5,571	76.1	73.8	79.7	68.5	63.4	69.3	71.9
6-26 Years	1,135	1,184	1,180	979	952	881	6,311	945	988	999	825	792	758	5,307	83.3	83.4	84.4	84.3	83.2	86.0	84.1

Table 7.--Reproductive condition, by month, of female fur seals collected by U.S. research vessels in Bering Sea in 1963

Age	Nulliparous	Primiparous			Multiparous			Total
		Nonpregnant	Pregnant		Nonpregnant	Pregnant		
Years	Number	Number	Number	Percent	Number	Number	Percent	Number
			July					
1	1	-	-	-	-	-	-	1
2	3	-	-	-	-	-	-	3
3	7	-	-	-	-	-	-	7
4	31	-	-	-	-	1	100.0	32
5	24	1	26	96.3	1	4	80.0	56
6	7	1	7	87.5	-	13	100.0	28
7	2	-	5	100.0	-	21	100.0	28
8	-	-	2	100.0	-	29	100.0	31
9	-	-	-	-	3	18	85.7	21
10	-	-	-	-	1	15	93.8	16
11	-	-	-	-	-	23	100.0	23
12	-	-	-	-	1	27	96.4	28
13	-	-	1	100.0	5	25	83.3	31
14	-	-	-	-	3	14	82.4	17
15	-	-	-	-	1	21	95.4	22
16	-	-	-	-	1	13	92.8	14
17	-	-	-	-	1	4	80.0	5
18	-	-	-	-	1	2	66.7	3
19	-	-	-	-	-	1	100.0	1
20	-	-	-	-	2	-	-	2
21	-	-	-	-	1	-	-	1
23	-	-	-	-	1	-	-	1
Total	75	2	41		22	231		371
Percent				95.3			91.3	
			August					
2	17	-	-	-	-	-	-	17
3	44	-	-	-	-	-	-	44
4	73	-	5	100.0	-	2	100.0	80
5	62	1	31	96.9	-	8	100.0	102
6	12	-	22	100.0	3	23	88.5	60
7	3	-	5	100.0	4	33	89.2	45
8	-	-	3	100.0	2	49	96.1	54
9	1	-	-	-	5	32	86.5	38
10	1	-	1	100.0	3	48	94.1	53
11	-	-	1	100.0	5	58	92.1	64
12	-	-	-	-	6	57	90.5	63
13	-	-	-	-	2	42	95.4	44
14	-	-	-	-	8	32	80.0	40
15	-	-	-	-	10	41	80.4	51
16	-	-	-	-	7	24	77.4	31
17	1	-	-	-	6	16	72.7	23
18	-	-	-	-	4	5	55.6	9
19	-	-	-	-	2	2	50.0	4
20	-	-	-	-	4	5	55.6	9
21	-	-	-	-	1	2	66.7	3
23	-	-	-	-	1	-	-	1
Total	214	1	68		73	479		835
Percent				98.6			86.8	
			September					
2	1	-	-	-	-	-	-	1
3	2	-	-	-	-	-	-	2
4	1	-	-	-	-	-	-	1
5	2	-	2	100.0	-	-	-	4
6	-	-	2	100.0	-	-	-	2
7	-	-	2	100.0	-	2	100.0	4
8	-	-	-	-	-	2	100.0	2
9	-	-	-	-	-	1	100.0	1
10	-	-	-	-	-	3	100.0	3
11	-	-	-	-	-	1	100.0	1
12	-	-	-	-	-	1	100.0	1
13	-	-	-	-	-	1	100.0	1
15	-	-	-	-	-	2	100.0	2
Total	6	-	6		-	13		25
Percent				100.0			100.0	
Grand total	295	3	115		95	723		1,231 2/

1/ Pregnant class includes post partum females.
2/ Thirteen seals of unknown age are omitted.

1963 is identical to that shown by data collected earlier in the eastern Pacific.

Fetal sex ratio and uterine horn of pregnancy.--Among pregnant females collected during 6 years of study, 1958 through 1963, pregnancies occurred most often in the left horn in 5 of the years as shown in table 8.

Table 8.--Fetal sex ratios and uterine horn of pregnancy, 1958-63

Year	Percent of pregnancies		Percent of fetus sex	
	Left horn	Right horn	Male	Female
1958	53.5	46.5	52.4	47.6
1959	51.2	48.8	48.9	51.1
1960	52.3	47.7	46.9	53.1
1961	52.2	47.8	48.0	52.0
1962	50.2	49.8	44.6	55.4
1963	47.7	52.3	53.8	46.2

The percentages given for 1963 are based on only 65 fetuses.

Anomalies

Gooseneck barnacles (Lepas pectinata) were found attached to the guard hairs on the back of a 7-year-old female fur seal taken on 13 July 1963 about 48 miles southeast of St. George Island. Thirty-seven barnacles were found, the capitulum of the largest being only 5 mm. long.

Food Habits

When compared with seals of the family Phocidae, the fur seal is a selective feeder, feeding exclusively on fish and cephalopods. In contrast, Pusa hispida (ringed seal), Phoca vitulina (harbor seal), and Erignathus barbatus (bearded seal) feed on a wide variety of fish, cephalopods, crustacea, mollusca, and other invertebrates. However, the species of fish and cephalopods consumed by the fur seal apparently is governed by their abundance and availability rather than by a tendency for the seals to be selective.

Mallotus villosus (capelin) and Ammodytes hexapterus (sand lance), two major food items in Alaskan waters, are relatively small, ranging in length from 5 to 12 cm. Fur seals are not limited to feeding on small fish, but are adaptable to a wide range in the size of prey that they capture and consume. Theragra chalcogrammus (walleye pollock) and Gonatus magister (squid) are among the larger fish and squids consistently eaten by fur seals in Alaskan waters. Specimens of Theragra from 12 to 45 cm. and specimens of Gonatus magister up to 20 cm. in mantle length have been recovered from fur seal stomachs.

As an example of extreme length of prey, in 1959 a Trachipterus trachypterus (king-of-the-salmon) 171.5 cm. long was recovered after a fur seal had brought the fish to the surface and was eating it. Except for digestive action, small fish are usually found in seal stomachs undamaged.

As is usually true, the Theragra and salmon specimens identified in 1963 were found broken into chunks and frequently the head was missing.

Specimens were identified by (1) comparing them with known skeletal remains or preserved specimens on file in the laboratory and (2) using keys by Berry (1912), Clemens and Wilby (1961), Evermann and Goldsborough (1906), Sasaki (1929), Schultz (1953), and Wilimovsky (1958)[5].

As in previous years, a few species of fish and cephalopods comprised the major portion of the stomach contents examined in 1963. The following were identified:

Clupea harengus pallasi (herring)
Oncorhynchus sp. (salmon)
Mallotus villosus (capelin)
Bathylagidae (deepsea smelts)
Myctophidae (lanternfishes)
Lampanyctus nannochir (lanternfish)
Gadidae (cods)
Theragra chalcogrammus (walleye pollock)
Sebastodes sp. (rockfish)
Pleurogrammus monopterygius (Atka mackerel)
Cottidae (sculpin)
Cyclopteridae (lumpsuckers)
Trichodontidae (sandfishes)
Trichodon trichodon (sandfish)
Ammodytes hexapterus (sand lance)
Pleuronectidae (righteye flounders)
Reinhardtius hippoglossoides (Greenland halibut)
Gonatidae (squid)
Gonatus fabricii (squid)
Gonatus magister (squid)
Gonatopsis sp. (squid)

For the first time since collecting began in 1958, Reinhardtius hippoglossoides, Lampanyctus nannochir, and Bathylagidae were identified in fur seal stomachs.

Observations at sea and stomach examinations for the past 5 years have shown that fur seals are primarily night and early morning feeders. The 1963 stomach collection verifies the results of previous years (fig. 6). Usually the number of stomachs containing food is

[5] N. J. Wilimovsky. 1958. Provisional keys to the fishes of Alaska. Bureau of Commercial Fisheries Biological Laboratory, Auke Bay, Alaska, 113 p. (Processed report.)

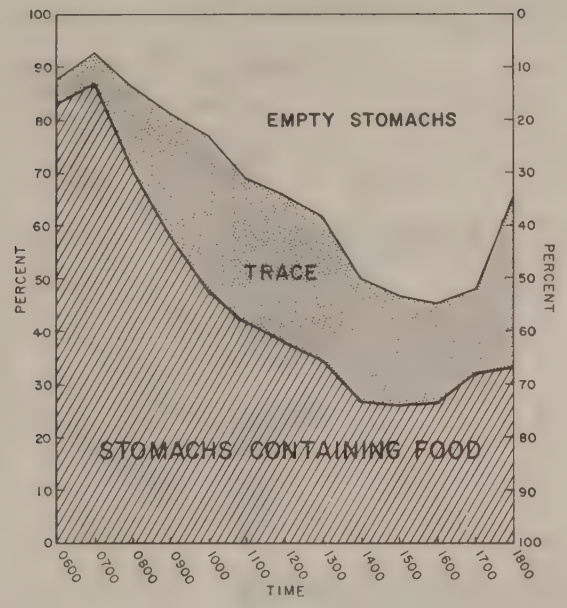


Figure 6.--The percent of stomachs containing food in relation to the time of collection, 1963.

greatest early in the morning and decreases until late afternoon. In areas where fish are abundant, seals have been observed actively feeding throughout the day.

The food and feeding habits of the fur seal were summarized by Fiscus, Baines, and Wilke (1964). In 1963, the entire collection of 1,355 seals was made in the Bering Sea. The results of stomach content examinations are shown in table 9, and the locations where the food species occurred in stomachs are shown in appendix figures 1 - 6.

Figure 7 presents the major food items by percent of volume of stomach contents, and the percent of frequency of occurrence in the stomachs. Food species that contributed more than 2 percent of the total volume are shown. They accounted for 97.1 percent of the total food volume, with squid replacing Mallotus as the major food item in 1963. Major food items usually remain the same each year in a given area, but individual rank may change.

Surface water temperatures encountered in the Bering Sea in 1963 ranged from 5° to 11° C. Similar temperatures were obtained in Bering Sea during 1960 and 1962 pelagic research. Surface water temperatures range from 5° to 6° C. in June; 6° to 9° C. in July; and 9°, 10°, and 11° C. in August. The temperatures most frequently encountered during summer in 1960, 1962, and 1963 were 8°, 9°, and 10° C.[6] A difference of 1° or 2° in surface water temperature was found between shallow and deep water areas; the deep water areas usually were warmer. Surface water temperature presumably influences the distribution of the food species of fish, but no apparent direct effect of temperature on food species or fur seals was noticed.

[6] Information based on data from daily field record sheets for 1960, 1962, and 1963.

Individual Food Items.--

Clupea harengus pallasi (Pacific herring)

Clupea were found in the stomachs of 15 fur seals collected in the shallow water areas of sectors 3, 4, 5, and 6. They represented 6.7 percent of the total volume of food and ranked fifth in importance as a food species. One stomach containing 22 herring accounted for 26 percent of total volume of this species found in 1963. The lengths of fish in this stomach were 28.5 - 31.0 cm. and the weights were 185-285 g. The areas of occurrence are shown in appendix figure 1.

Oncorhynchus (salmon)

Oncorhynchus were found in 14 seal stomachs in 1963 that were collected throughout all sectors. They represented 2.6 percent of the total volume of food and were seventh in importance by volume as a food species.

Specific identification was made from scales of salmon from six stomachs by Kenneth Mosher of the Bureau of Commercial Fisheries Biological Laboratory, Seattle. Three stomachs contained 2-year-old chum salmon, O. keta; one contained a 3-year-old chum salmon and two contained pink salmon, O. gorbuscha. The areas of occurrence are shown in appendix figure 2.

Mallotus villosus (capelin)

Mallotus ranked second as a food species by volume, occurred in 140 stomachs, and represented 20.0 percent of the total volume of food. The heaviest concentration of Mallotus was on the feeding grounds just north of Unalaska Island as shown in appendix figure 3.

Bathylagidae

Ninety-two stomachs contained a species of fish identified as belonging to the family Bathylagidae.[7] Bathylagidae ranked fourth in importance by volume as a food species and represented 7.2 percent of the total volume of food. Because the fish were in very poor condition and comparative specimens were not available, specific identification was not made. Jordan and Gilbert (1899) described a new

[7] The assistance of N. J. Willimovsky, University of British Columbia, Vancouver, B. C., led to our identification of these fish.

Table 9.--Stomach contents of fur seals from Bering Sea, 1 July to 5 September 1963

Food item	Volume		Frequency	Frequency of trace[1]
	Cc.	Percent	Number	Number
Clupea harengus pallasi	18,825	6.7	15	2
Oncorhynchus sp.	7,131	2.6	14	1
Mallotus villosus	55,770	20.0	140	17
Bathylagidae	20,109	7.2	92	10
Myctophidae	15	-	2	-
Lampanyctus nannochir	10	-	1	-
Gadidae	3,043	1.1	11	2
Theragra chalcogrammus	21,646	7.7	47	9
Sebastodes sp.	270	.1	1	-
Pleurogrammus monopterygius	7,486	2.7	13	2
Cottidae	-	-	1	1
Cyclopteridae	122	-	2	-
Trichodontidae	120	-	1	-
Trichodon trichodon	12	-	1	-
Ammodytes hexapterus	1,860	.7	15	5
Pleuronectidae	550	.2	11	1
Reinhardtius hippoglossoides	1,777	.6	16	5
Unidentified fish	647	.2	59	49
Decapoda (squid)				
Gonatidae	8,691	3.1	630	547
Gonatus fabricii	4,552	1.6	289	201
Gonatus magister	62,187	22.2	164	8
Gonatopsis sp.	65,386	23.3	281	15
Pebbles	-	-	32	32
Mollusca (shells)	-	-	19	19
Organic material	-	-	1	1
Isopoda	-	-	3	3
Crustacea	-	-	4	4
Totals	280,209	100.0		
Stomachs with food	816			
Stomachs empty	538			
Stomachs missing	1			
	1,355			

[1] Trace counts are included in frequency counts. (Trace = an occurrence in which there is no measurable amount of volume, usually only a few vertebra or squid beaks.)

species, Therobromus callorhinus, called seal fish, from vertebrae found in fur seal stomachs taken in the Bering Sea. They placed it, somewhat tentatively, in the family Argentiidae. Chapman (1943) subsequently identified T. callorhinus as a species of Bathylagus. This year was the first since T. callorhinus was described that "seal fish" or a similar fish has been identified from fur seals collected in the Bering Sea.

Practically all bathylagids found in 1963 occurred in stomachs from deep water areas of the Bering Sea (appendix fig. 1).

Myctophidae

Three stomachs from fur seals collected in deep water just north of Unalaska Island contained lanternfish (appendix fig. 4). One specimen collected on 1 August was identified as Lampanyctus nannochir. The genus and species of the other two lanternfish collected on 3 and 9 August in the same vicinity could not be determined.

Gadidae

Fish belonging to the family Gadidae occurred in 58 stomachs examined in 1963, representing 8.8 percent of the total volume of food. Theragra chalcogrammus accounted for 7.7 percent (47 occurrences) of the total food volume, 4.7 percent less than in 1962 (Fiscus, Baines, and Wilke, 1964). This fish is considered one of the main food species

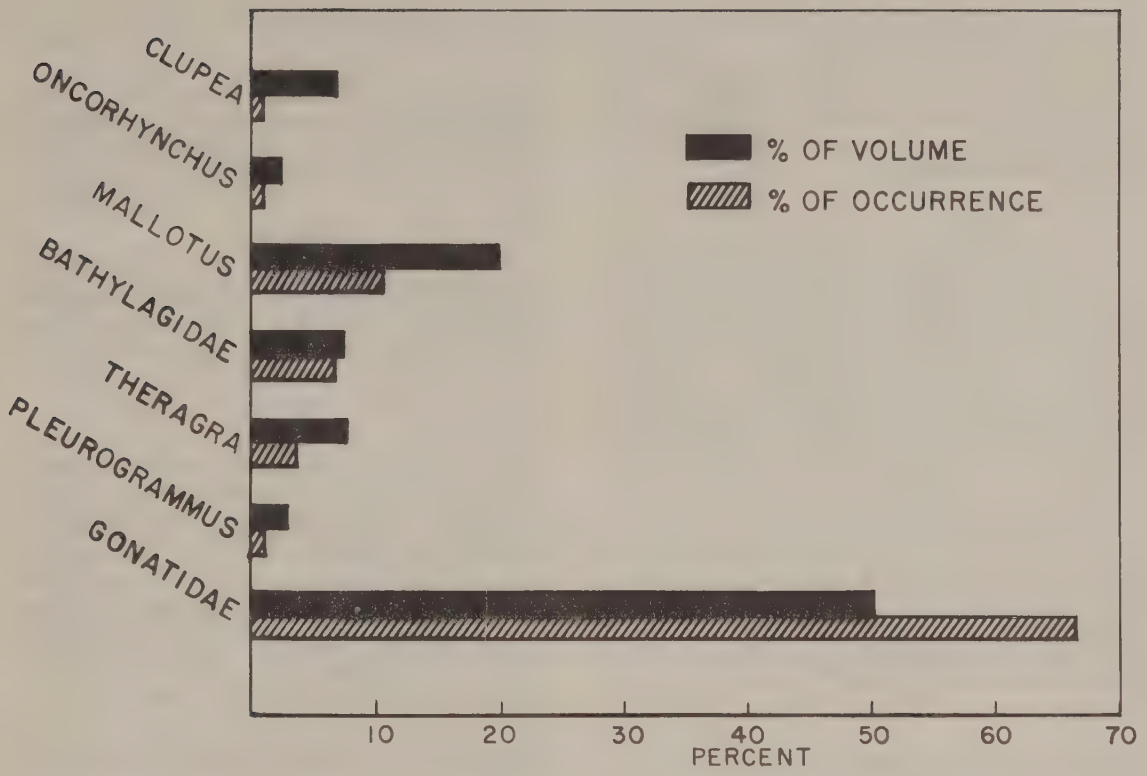


Figure 7.--Percent of stomach content volume and percent of occurrence in stomachs of the principal food species found in 1963.

of fur seals in the Bering Sea. In stomachs from seals collected in the Bering Sea and Unimak Pass area in 1960 (Niggol, Fiscus, O'Brien, and Wilke)[8], Theragra composed 65.7 percent of the total volume. The areas of occurrence are shown in appendix figure 2.

Sebastodes sp. (rockfish)

Sebastodes sp. were found in one stomach collected near Akutan Pass in lat. 54°08' N., long. 166°21' W. (appendix fig. 5).

Pleurogrammus monopterygius (Atka mackerel)

Pleurogrammus were found in 13 stomachs and represented 2.7 percent of total volume of food. They ranked sixth in importance as a food species. The area of occurrence is shown in appendix figure 2.

[8] Karl Niggol, Clifford H. Fiscus, Jr., Thomas P. O'Brien, and Ford Wilke. 1960. Pelagic fur seal investigations, Alaska, 1960. Bureau of Commercial Fisheries, Marine Mammal Biological Laboratory, Seattle, Wash. (Manuscript report.)

Cottidae

The preopercular spine of one cottid was found.

Cyclopteridae

Traces of Cyclopteridae were identified from two fur seal stomachs. One seal was collected 55 miles northwest of Cape Cheerful, Unalaska Island; the other, 76 miles southwest of St. George Island. Both were collected in deep water of sectors 1 and 2. Cyclopterids have been reported previously as occurring in fur seal stomachs from the Gulf of Alaska (Niggol, Fiscus, O'Brien, and Wilke[9]).

Trichodontidae

Two trichodontids were identified from fur seals killed near the Pribilof Islands (appendix fig. 4). One was identified as Trichodon trichodon. Sandfish have been reported previously by Kenyon (1956) in stomachs from St. Paul Island, and by Niggol, Fiscus, O'Brien, and Wilke[10].

[9] See footnote 8.

[10] See footnote 8.

Ammodytes hexapterus (sand lance)

Ammodytes occurred in 15 seal stomachs examined in 1963. As in 1962, it was a minor food species in the Bering Sea. More Ammodytes were found in zone 1 than any other species (appendix fig. 1).

Pleuronectidae

Twenty-seven occurrences (appendix fig. 5) of Pleuronectidae were noted from fur seal stomachs collected in shallow water of sectors 3, 4, and 5. Reinhardtius hippoglossoides were identified from 16 stomachs. One seal stomach contained 500 of this species. They comprised 67 percent of all flounders identified as Reinhardtius [11]. The lengths of 14 specimens were 45-60 mm. from the tip of snout to the end of the hypural plate, and the average body weight of 10 specimens was 1.5 g.

Reinhardtius hippoglossoides were reported twice in the literature as occurring in the Pacific Ocean and the Bering Sea. Andriashev (1937) reported this species in the Bering and Okhotsk Seas, and, in August 1962, a male Reinhardtius was identified from a trawl catch off the coast of California (Best, 1963).

Squids

Squids were the major food found in fur seal stomachs collected in 1963. The following identifications were made, and the corresponding total food volumes in percent are: Gonatidae (3.1 percent), Gonatus fabricii (1.6 percent), Gonatus magister (22.2 percent) and Gonatopsis sp. (23.3 percent). Gonatids comprised over one-half of the total volume of food.

All squid remains that could not be identified to species were listed as belonging to the family Gonatidae.

Of the three identified gonatids, Gonatus fabricii ranked least in importance by total volume (1.6 percent), but first by frequency of occurrence. The reasons for the disparity between volume and frequency of occurrence are: (1) G. fabricii are very soft bodied and are broken up and digested more rapidly than either G. magister or Gonatopsis sp., and (2) the beaks of G. fabricii can be distinguished readily from those of the other two gonatids, which makes specific identification possible when only beaks are present.

G. magister, which ranked second in importance by volume, ranked last in frequency of occurrence. On the average, G. magister were consistently largest of the three identified squids, accounting for the discrepancy between total volume and frequency of occurrence.

Gonatopsis sp. were the most easily recognized of the three squids because (1) they have no tentacles and (2) their head and arm regions seem to be more resistant to digestion than comparable parts of the other squids. Gonatopsis beaks are not readily distinguishable from those of G. magister.

The three squids seemed to be equally distributed over the 1963 deep water collection areas (sectors 1 and 2) of the Bering Sea (appendix figs. 4, 5, and 6). Their distribution did not differ materially from that of 1962 (Fiscus, Baines, and Wilke, 1964).

Miscellaneous

A fragment of sea weed was found in one stomach. Gastropod or pelecypod fragments were found in 19 stomachs. There were seven occurrences of crustaceans; two were unidentified fragments; two were hermit crabs, Pagurus sp., in gastropod shells; and three were the parasitic isopod, Rocinela belliceps.

Pebbles found in 32 stomachs ranged from 2 to 44 mm. in diameter. Most pebbles were found in stomachs from seals collected in shallow water (less than 100 fathoms).

Relation of Fur Seals to Commercial Fisheries

Three species eaten by seals, Clupea, Oncorhynchus, and Theragra, are fished commercially in the Bering Sea. Clupea are regularly fished by the Soviet and Japanese fishing fleets. In 1960, Clupea were not found in stomachs from fur seals collected in the Bering Sea. One occurrence was noted in 1962. In 1963, there were 15 occurrences which comprised 6.7 percent of the total stomach content volume.

Oncorhynchus are the object of an intensive high seas fishery west of 175° east longitude and an intensive inshore fishery along the Alaskan coast. Oncorhynchus made up 3.7 percent (6 occurrences) of the total stomach content volume in 1960, 6.2 percent (8 occurrences) in 1962, and 2.6 percent (14 occurrences) in 1963.

Theragra have been important in the catch of Soviet and Japanese bottom fishing fleets and also have been an important food of the fur seal. In 1960, Theragra made up 65.7 percent (109 occurrences) of the stomach content volume; in 1962, 41.6 percent (81 occurrences); and in 1963, 7.7 percent (41 occurrences).

The effect of the fur seal upon Clupea and Oncorhynchus is impossible to appraise sep-

[11] Identified by N. J. Wilimovsky of the University of British Columbia, Vancouver, B. C.

arately from the other predation on these species. The decline of Theragra over the past 4 years as a fur seal food species may indicate a reduced population; intensive bottom fishing by the Japanese and Soviets during the past few years coincides with the decline of this species as a fur seal food. No study of Theragra populations in the Bering Sea has been made, however.

SUMMARY

The sixth year of pelagic fur seal research under terms of the Interim Convention on Conservation of North Pacific Fur Seals was conducted in the Bering Sea from 1 July to 5 September 1963.

Two purse seine vessels, the M/V Harmony and the M/V Tacoma, were chartered in 1963. The vessels sailed parallel courses from the Strait of Juan de Fuca to Unimak Pass from 20 to 28 June.

Of 82 seals sighted, 44 were seen on the first and last days when the vessels were within 75 to 100 miles of land. Offshore distribution of seals appeared uneven. The movements of fur seals in offshore areas of the eastern North Pacific are not fully known, and information available is not adequate to show population changes from year to year.

A study was made of distribution, abundance, and food habits of fur seals on their summer range in the Bering Sea. To aid in the analysis of data, the eastern Bering Sea was divided into six major sectors centered between St. Paul and St. George Islands. The sectors were then divided into zones, each 30 nautical miles wide and extending to the sector boundaries.

The distribution of seals in the first three zones of sectors 1 through 6 appeared uniform. Distribution in the outer zones appeared uneven, with seal concentrations in areas of abundant food supply.

The variation in numbers of seals seen and collected by 10-day periods was caused by changes in the weather and the locality where collections were made rather than by any sudden rise or decline in the fur seal population of the Bering Sea.

Seals were seen in groups rather than in large herds. In 1963, groups of one, two, and three seals accounted for 90.3 percent of the total sightings.

Of 1,355 seals collected in 1963, 111 were males and 1,244 were females. Five-year-olds predominated among females. The relative distribution of males and females, with only three exceptions, was fairly uniform.

Post partum females predominated in the early July collections in sectors 1 and 2, zones 3 and 4, and in the feeding areas of the outer zones from mid-July to early September.

The first adult males found away from the Pribilof Islands were seen 5-20 miles northwest of Akun Island on 31 July. In August they were found widely scattered at sea. More males were collected in Alaska waters than in the waters off California, Oregon, and Washington.

Male and female seals were observed together at sea, and special efforts were made to study mating of fur seals at sea. The information obtained was inconclusive.

The number of tags recovered by pelagic vessels has steadily increased since 1958; 43 tagged animals were taken in 1963.

The mean lengths of 4,074 pregnant, 1,528 post partum, and 2,353 nonpregnant females collected from 1958 through 1963 are compared. The lengths of nonpregnant and post partum seals agree more closely than do the lengths of pregnant and post partum seals. For unknown reasons, pregnant females apparently decrease in length after parturition.

The average pregnancy rate of 84.1 percent for females 6 years old and older is uniform for the 6 collection years. This rate decreases to 71.9 percent if 3-, 4-, and 5-year-old females are included.

The fur seal feeds exclusively on fish and cephalopods. The species taken apparently are controlled by quantity and availability of fish and cephalopods rather than by a tendency to be selective.

Seals capture and consume prey varying greatly in size. Food items ranging in length from 5 to 45 cm. were removed from stomachs collected in 1963.

Small prey such as Mallotus, Ammodytes, and squid usually are captured and consumed below the surface while larger fish such as Theragra generally are eaten at the surface. Larger fish generally appear in seal stomachs in chunks or with part of the body missing. Theragra and Oncorhynchus identified in stomachs in 1963 were found in this condition.

The following fish and squids were identified from stomachs taken in 1963: Clupea harengus pallasi (herring), Oncorhynchus sp. (salmon), Mallotus villosus (capelin), Bathylagidae (deepsea smelts), Myctophidae (lanternfishes), Lampanyctus nannochir (lanternfish), Gadidae (cods), Theragra chalcogrammus (walleye pallock), Sebastodes sp. (rockfish), Pleurogrammus monopterygius (Atka mackerel), Cottidae (sculpin), Cyclopteridae (lumpsuckers), Trichodontidae (sandfishes), Ammodytes hexapterus (sand lance), Pleuronectidae (righteye flounders), Reinhardtius hippoglossoides (Greenland halibut), Gonatidae (squid), Gonatus fabricii (squid), Gonatus magister (squid), and Gonatopsis sp. (squid).

Reinhardtius hippoglossoides, Lampanyctus nannochir, and Bathylagidae were identified

from fur seal stomachs for the first time since collecting began in 1958.

The data from 1963 stomach collections verified the conclusion that seals are primarily night and early morning feeders.

Surface water temperature varied from 5° to 11° C. during the 1963 field season. Fur seal distribution was apparently not directly regulated by temperature.

The ranking food items by volume and the frequency with which they were found in fur seal stomachs in 1963 were: Squid (>630), Mallotus (140), Theragra (47), Bathylagidae (92), Clupea (15), Pleurogrammus (13), and Oncorhynchus sp. (14).

Nonfood items in stomachs were gastropod and pelecypod fragments, crustaceans, isopods, and pebbles.

Three fish eaten by fur seals, Clupea, Oncorhynchus, and Theragra, are fished commercially in the Bering Sea. The effect of fur seals upon Clupea and Oncorhynchus is not clear but appears to be negligible. The decline of Theragra coincides with heavy fishing pressure by trawlers.

LITERATURE CITED

ANDRIASHEV, ANATOLY P.
1937. A contribution to the knowledge of the fishes from the Bering and Chukchi Seas. Hydrographical Institute, Leningrad, Exploration des mers de l'URSS, fasc. 25, p. 292-355. (Translated by Lisa Lanz and N. J. Wilimovsky, U.S. Fish and Wildlife Service, Special Scientific Report--Fisheries No. 145, 81 p. 1955.)

BERRY, S. S.
1912. A review of the cephalopods of western North America. Bulletin [U.S.] Bureau of Fisheries, vol. 32, p. 257-362.

BEST, E. A.
1963. Greenland halibut, Reinhardtius hippoglossoides (Walbaum), added to California fauna. California Fish and Game, vol. 49, no. 3, p. 213-214.

CHAPMAN, W. M.
1943. The osteology and relationships of the bathypelagic fishes of the genus Bathylagus Gunther with notes on the systematic position of Leuroglossus stilbius Gilbert and Therobromus callorhinus Lucas. Journal of the Washington Academy of Sciences, vol. 33, no. 5, p. 147-160.

CLEMENS, W. A., and G. V. WILBY.
1961. Fishes of the Pacific Coast of Canada. Fisheries Research Board of Canada, Bulletin No. 68 (2d edition), 368 p.

EVERMANN, BARTON WARREN, and EDMUND LEE GOLDSBOROUGH.
1906. The fishes of Alaska. [U.S.] Bureau of Fisheries Document 624, p. 219-360, pl. 23 to 42.

FISCUS, CLIFFORD H., GARY A. BAINES, and FORD WILKE.
1964. Pelagic fur seal investigations, Alaskan waters, 1962. U.S. Fish and Wildlife Service, Special Scientific Report--Fisheries No. 475, 59 p.

JORDAN, DAVID STARR, and CHARLES HENRY GILBERT.
1899. The fishes of Bering Sea. In The fur seals and fur-seal islands of the North Pacific Ocean. U.S. Treasury Department Document 2017, Part 3, p. 440-441.

KENYON, KARL W.
1956. Food of fur seals taken on St. Paul Island, Alaska, 1954. Journal of Wildlife Management, vol. 20, no. 2, p. 214-215.

KENYON, KARL W., and FORD WILKE.
1953. Migration of the northern fur seal, Callorhinus ursinus. Journal of Mammalogy, vol. 34, no. 1, February, p. 86-89.

ROPPEL, ALTON Y., ANCEL M. JOHNSON, RICHARD D. BAUER, DOUGLAS G. CHAPMAN, and FORD WILKE.
1963. Fur seal investigations, Pribilof Islands, Alaska, 1962. U.S. Fish and Wildlife Service, Special Scientific Report--Fisheries No. 454, 101 p.

SASAKI, MADOKA.
1929. A monograph of the dibranchiate cephalopods of the Japanese and adjacent waters. Journal of Faculty of Agriculture, Hokkaido Imperial University, Sapporo, vol. 20, suppl., 357 p., 30 pls.

SCHULTZ, L. P.
1936. Keys to the fishes of Washington, Oregon, and closely adjoining regions. University of Washington Publications in Biology, 4th printing, 1953, vol. 2, no. 4, p. 103-228.

TAYLOR, F. H. C., M. FUJINAGA, and FORD WILKE.
1955. Distribution and food habits of the fur seals of the North Pacific Ocean. U.S. Department of the Interior, Fish and Wildlife Service, Washington, 86 p.

TOWNSEND, C. H.
1899. Pelagic sealing. In The fur seals and fur-seal islands of the North Pacific Ocean. U.S. Treasury Department Document 2017, Part 3, p. 223-274.

Appendix A

Appendix table 1.--Number and relative abundance of seals seen in Bering Sea, by 10-day periods, 1 July to 5 September 1963

Period	Boat hunting days[1]	Total seals seen	Seals seen per boat-hunting day	Seals seen per 10-day interval
	Number	Number	Number	Percent
1-10 July	12.75	362	28.4	6.3
11-20 "	7.50	362	48.3	6.3
21-31 "	12.50	902	72.2	15.5
1-10 August	14.50	1,554	107.2	26.8
11-20 "	11.50	922	80.2	15.9
21-31 "	19.00	1,296	68.2	22.4
1-10 September	6.00	392	53.3	6.8
Total	83.75	5,790	69.1	100.0

[1] See footnote 4, page 3.

Appendix table 2.--Number and relative abundance of seals collected in Bering Sea, by 10-day periods, 1 July to 5 September 1963

Period	Boat-hunting days[1]	Seals collected			Seals collected per boat-hunting day	
		Males	Females	Total		
	Number	Number	Number	Number	Number	Percent
1-10 July	12.75	12	94	106	8.3	7.8
11-20 "	7.50	20	90	110	14.7	8.1
21-31 "	12.50	24	188	212	17.0	15.7
1-10 August	14.50	14	421	435	30.0	32.1
11-20 "	11.50	26	244	270	23.5	19.9
21-31 "	19.00	11	182	193	10.2	14.3
1-10 September	6.00	4	25	29	4.8	2.1
Total	83.75	111	1,244	1,355	16.2	100.0

[1] See footnote 4, page 3.

Appendix table 3.--Number and relative abundance of seals seen and collected, 1958-63[1]

Year	Area of operations	Boat-hunting days[2]	Total seals seen	Average seen per boat-hunting day	Total seals collected	Average collected per boat-hunting day
		Number	Number	Number	Number	Number
1958	California to Alaska.....	222.00	7,024	31.6	1,503	6.8
1959	California to Washington.....	169.75	5,919	34.9	1,548	6.9
1960	Alaska.....	146.75	6,287	42.8	1,495	10.2
1961	California to British Columbia	134.50	3,415	25.4	1,352	10.1
1962	Alaska.....	106.50	6,111	57.4	1,486	14.0
1963	Alaska.....	83.75	5,790	69.1	1,355	16.2

[1] Data from annual pelagic reports.
[2] See footnote 4, page 3.

Appendix table 4.--Grouping of 5,790 seals sighted in Bering Sea, 1 July to 5 September 1963

	Number of seals per group											
	1	2	3	4	5	6	7	8	9	10	10+	Total
Number of groups...	2,842	814	255	84	25	5	2	2	1	1	1	4,032
Number of seals....	2,842	1,628	765	336	125	30	14	16	9	10	15	5,790
Percent of seals...	49.0	28.1	13.2	5.8	2.2	0.5	0.2	0.3	0.2	0.2	0.3	100.0

Appendix table 5.--Total seals sighted, collected, wounded and lost, and killed and lost, 1958-63

Year	Total seals sighted	Sighted seals					
		Collected		Wounded and lost		Killed and lost	
	Number	Number	Percent	Number	Percent	Number	Percent
1958.....	7,024	1,503	21.4	302	4.3	255	3.6
1959.....	5,919	1,548	26.2	316	5.3	286	4.8
1960.....	6,287	1,495	23.8	271	4.3	241	3.8
1961.....	3,415	1,352	40.0	176	5.2	124	3.6
1962.....	6,111	[1] 1,483	24.3	178	2.9	133	2.2
1963.....	5,790	1,355	23.4	202	3.5	143	2.5
Combined years.	34,546	8,736	25.3	1,445	4.2	1,182	3.4

[1] Excludes three seals collected in the Gulf of Alaska.

Appendix table 6.--Number and percent of seals shot at sea that were collected, wounded and lost, or killed and lost, 1958-63

Year	Total seals shot	Seals shot					
		Collected		Wounded and lost		Killed and lost	
	Number	Number	Percent	Number	Percent	Number	Percent
1958.....	2,060	1,503	73.0	302	14.6	255	12.4
1959.....	2,150	1,548	72.0	316	14.7	286	13.3
1960.....	2,007	1,495	74.5	271	13.5	241	12.0
1961.....	1,652	1,352	81.8	176	10.7	124	7.5
1962.....	1,794	1,483	82.7	178	9.9	133	7.4
1963.....	1,700	1,355	79.7	202	11.9	143	8.4
Combined years.	11,363	8,736	76.9	1,445	12.7	1,182	10.4

Appendix table 7.--Mean lengths of pregnant fur seals collected by U.S. research vessels in Bering Sea in July 1963

Age	Seals	Mean length	Standard deviation
Years	Number	Cm.	Cm.
5.....	16	119.7	4.8
6.....	6	124.0	3.0
7.....	5	125.0	3.0
8.....	9	124.1	4.0
9.....	5	127.2	2.6
10.....	3	129.0	9.0
11.....	6	130.7	3.9
12.....	3	132.3	5.8
13.....	5	128.4	5.1
14.....	2	129.0	4.2
15.....	4	130.2	5.2
16.....	1	133.0	-
Total	65		

Appendix table 8.--Mean weights of pregnant fur seals collected by U.S. research vessels in Bering Sea in July 1963

Age	Seals	Mean weight	Standard deviation
Years	Number	Kg.	Kg.
5.....	16	40.6	4.5
6.....	6	42.7	4.6
7.....	5	42.4	2.8
8.....	9	44.0	4.9
9.....	5	45.4	3.6
10.....	3	47.3	6.8
11.....	6	49.2	5.6
12.....	3	54.7	11.6
13.....	5	47.4	4.5
14.....	2	55.5	9.2
15.....	4	53.2	6.4
16.....	1	57.0	-
Total	65		

Appendix table 9.--Monthly mean lengths of post partum fur seals collected by U.S. research vessels in Bering Sea in 1963

Age	July		August		September		Combined length		
	Seals	Mean length	Seals	Mean length	Seals	Mean length	Seals	Mean	Standard deviation
Years	Number	Cm.	Number	Cm.	Number	Cm.	Number	Cm.	Cm.
4....	1	119.0	7	115.7	-	-	8	116.1	8.2
5....	15	114.9	39	117.5	2	116.0	56	116.8	4.3
6....	14	118.9	45	119.8	2	117.0	61	119.5	4.5
7....	22	118.3	37	122.8	4	121.5	63	121.2	5.2
8....	22	122.0	52	124.1	2	123.0	76	123.5	4.9
9....	13	120.7	32	124.3	1	122.0	46	123.2	5.3
10....	12	125.0	49	124.1	3	128.7	64	124.5	5.5
11....	17	123.8	59	125.5	1	125.0	77	125.1	4.6
12....	24	123.2	57	125.4	1	125.0	82	124.7	5.8
13....	21	123.7	42	127.9	1	129.0	64	126.5	5.0
14....	12	128.5	32	128.6	-	-	44	128.6	4.8
15....	17	129.4	40	127.6	2	127.5	59	128.2	5.5
16....	12	127.8	24	127.4	-	-	36	127.5	5.0
17....	4	125.7	16	129.4	-	-	20	128.7	6.3
18....	2	129.0	5	128.6	-	-	7	128.7	3.8
19....	1	121.0	2	122.5	-	-	3	122.0	1.0
20....	-	-	5	128.2	-	-	5	128.2	5.1
21....	-	-	2	129.0	-	-	2	129.0	0.0
Total.	209		545		19		[1] 773		

[1] One seal of unknown length and nine seals of unknown age are omitted.

Appendix table 10.--Monthly mean weights of post partum fur seals collected by U.S. research vessels in Bering Sea in 1963

Age	July		August		September		Combined weight		
	Seals	Mean weight	Seals	Mean weight	Seals	Mean weight	Seals	Mean	Standard deviation
Years	Number	Kg.	Number	Kg.	Number	Kg.	Number	Kg.	Kg.
4....	1	31.0	7	30.4	-	-	8	30.5	6.3
5....	15	28.5	39	29.9	2	27.5	56	29.5	3.8
6....	14	29.3	45	32.7	2	25.5	61	31.7	4.6
7....	22	29.9	37	34.8	4	31.7	63	32.9	4.8
8....	22	32.7	52	35.6	2	34.0	76	34.7	4.2
9....	13	32.5	32	36.2	1	37.0	46	35.1	4.5
10....	12	36.9	49	36.8	3	40.3	64	37.0	5.0
11....	17	35.9	59	38.2	1	37.0	77	37.7	4.7
12....	24	35.2	57	38.0	1	37.0	82	37.2	5.3
13....	21	37.2	42	40.7	1	36.0	64	39.5	5.3
14....	12	39.7	32	41.3	-	-	44	40.9	6.0
15....	17	42.2	40	41.3	2	44.0	59	41.6	5.4
16....	12	40.2	24	39.9	-	-	36	40.0	5.4
17....	4	35.7	16	43.0	-	-	20	41.5	6.0
18....	2	42.0	5	41.0	-	-	7	41.3	3.5
19....	1	35.0	2	35.0	-	-	3	35.0	0.0
20....	-	-	5	42.2	-	-	5	42.2	4.0
21....	-	-	2	43.5	-	-	2	43.5	0.7
Total.	209		545		19		[1] 773		

[1] One seal of unknown weight and nine seals of unknown age are omitted.

Appendix table 11.--Monthly mean lengths of nonpregnant fur seals collected by U.S. research vessels in Bering Sea in 1963

Age	July		August		September		Combined length		
	Seals	Mean length	Seals	Mean length	Seals	Mean length	Seals	Mean	Standard deviation
Years	Number	Cm.	Number	Cm.	Number	Cm.	Number	Cm.	Cm.
1....	1	77.0	-	-	-	-	1	77.0	-
2....	3	97.0	17	99.1	1	89.0	21	98.3	6.1
3....	7	107.0	44	105.1	2	104.0	53	105.3	3.8
4....	31	111.5	73	112.5	1	106.0	105	112.2	4.8
5....	25	118.4	63	117.0	2	115.0	90	117.4	4.9
6....	8	119.0	15	118.3	-	-	23	118.5	4.8
7....	2	124.0	7	126.6	-	-	9	126.0	5.1
8....	-	-	2	129.0	-	-	2	129.0	0.0
9....	3	123.3	6	125.2	-	-	9	124.6	6.2
10....	1	115.0	4	126.0	-	-	5	123.8	5.5
11....	-	-	5	127.0	-	-	5	127.0	4.6
12....	1	120.0	6	127.5	-	-	7	126.4	6.0
13....	5	124.2	2	127.5	-	-	7	125.1	3.4
14....	3	125.7	8	125.4	-	-	11	125.5	3.4
15....	1	126.0	10	125.1	-	-	11	125.1	6.6
16....	1	129.0	7	126.4	-	-	8	126.7	3.3
17....	1	126.0	7	129.0	-	-	8	128.6	4.8
18....	1	130.0	4	124.7	-	-	5	125.8	3.3
19....	-	-	2	127.0	-	-	2	127.0	1.4
20....	2	124.0	4	125.0	-	-	6	124.7	6.1
21....	1	132.0	1	136.0	-	-	2	134.0	2.8
23....	1	131.0	1	117.0	-	-	2	124.0	9.9
Total.	98		288		6		[1] 392		

[1] Three seals of unknown age are omitted.

Appendix table 12.--Monthly mean weights of nonpregnant fur seals collected by U.S. research vessels in Bering Sea in 1963

Age	July		August		September		Combined weight		
	Seals	Mean weight	Seals	Mean weight	Seals	Mean weight	Seals	Mean weight	Standard deviation
Years	Number	Kg.	Number	Kg.	Number	Kg.	Number	Kg.	Kg.
1....	1	9.0	-	-	-	-	1	9.0	-
2....	3	16.7	17	18.9	1	15.0	21	18.4	3.1
3....	7	22.7	44	22.2	2	18.0	53	22.1	2.7
4....	31	26.0	73	27.3	1	19.0	105	26.9	3.7
5....	25	31.5	63	29.7	2	27.0	90	30.2	4.7
6....	8	30.5	15	31.7	-	-	23	31.3	4.0
7....	2	37.0	7	36.6	-	-	9	36.7	4.0
8....	-	-	2	40.5	-	-	2	40.5	6.4
9....	3	35.0	6	34.7	-	-	9	34.8	5.8
10....	1	37.0	4	35.7	-	-	5	36.0	3.4
11....	-	-	5	39.2	-	-	5	39.2	5.6
12....	1	32.0	6	41.0	-	-	7	39.7	7.1
13....	5	37.6	2	47.0	-	-	7	40.3	6.1
14....	3	41.7	8	38.1	-	-	11	39.1	5.3
15....	1	43.0	10	40.4	-	-	11	40.6	3.7
16....	1	49.0	7	38.6	-	-	8	39.9	5.9
17....	1	39.0	7	41.9	-	-	8	41.5	5.1
18....	1	44.0	4	40.5	-	-	5	41.2	6.2
19....	-	-	2	41.0	-	-	2	41.0	4.2
20....	2	36.0	4	38.2	-	-	6	37.5	2.3
21....	1	40.0	1	42.0	-	-	2	41.0	1.4
23....	1	43.0	1	40.0	-	-	2	41.5	2.1
Total.	98		288		6		[1] 392		

[1] Three seals of unknown age are omitted.

Appendix table 13.--Monthly mean lengths of male fur seals collected by U.S. research vessels in Bering Sea in 1963

Age	July		August		September		Combined length		
	Seals	Mean length	Seals	Mean length	Seals	Mean length	Seals	Mean	Standard deviation
Years	Number	Cm.	Number	Cm.	Number	Cm.	Number	Cm.	Cm.
1....	1	102.0	2	97.0	1	99.0	4	98.7	6.2
2....	6	105.5	26	104.2	2	101.0	34	104.2	4.3
3....	18	112.7	7	113.0	1	103.0	26	112.4	5.4
4....	10	119.4	4	121.0	-	-	14	119.9	3.2
5....	11	133.5	4	144.7	-	-	15	136.5	7.8
6....	2	147.0	-	-	-	-	2	147.0	4.2
7....	3	185.0	1	149.0	-	-	4	176.0	33.5
8....	2	159.5	3	170.7	-	-	5	166.2	9.6
9....	1	172.0	1	175.0	-	-	2	173.5	2.1
11....	-	-	1	184.0	-	-	1	184.0	-
12....	1	197.0	1	198.0	-	-	2	197.5	0.7
14....	-	-	1	196.0	-	-	1	196.0	-
15....	1	194.0	-	-	-	-	1	194.0	-
Total.	56		51		4		111		

Appendix table 14.--Monthly mean weights of male fur seals collected by U.S. research vessels in Bering Sea in 1963

Age	July		August		September		Combined weights		
	Seals	Mean weight	Seals	Mean weight	Seals	Mean weight	Seals	Mean weight	Standard deviation
Years	Number	Kg.	Number	Kg.	Number	Kg.	Number	Kg.	Kg.
1....	1	22.0	2	17.0	1	20.0	4	19.0	2.9
2....	6	21.2	26	20.9	2	18.2	34	20.8	3.5
3....	18	28.3	7	26.9	1	20.0	26	27.6	4.6
4....	10	32.6	4	32.5	-	-	14	32.6	2.6
5....	11	46.3	4	59.0	-	-	15	49.7	8.4
6....	2	62.0	-	-	-	-	2	62.0	2.8
7....	3	102.0	1	70.0	-	-	4	94.0	29.8
8....	2	87.5	3	104.7	-	-	5	97.8	15.9
9....	1	90.0	1	106.0	-	-	2	98.0	11.3
11....	-	-	1	128.0	-	-	1	128.0	-
12....	1	95.0	1	135.0	-	-	2	115.0	28.3
14....	-	-	1	110.0	-	-	1	110.0	-
15....	1	155.0	-	-	-	-	1	155.0	-
Total.	56		51		4		111		

Appendix table 15.--Mean lengths of fur seal fetuses collected by U.S. research vessels in eastern Pacific, 1958-63

[1958-61]

Period	1958				1959				1960				1961			
	Male		Female		Male		Female		Male		Female		Male		Female	
	Fetuses	Mean length	Fetuses	Mean length	Fetuses	Mean length	Fetuses	Mean length	Fetuses	Mean length	Fetuses	Mean length	Fetuses	Mean length	Fetuses	Mean length
	Number	Cm.	Number	Cm.	Number	Cm.	Number	Cm.	Number	Cm.	Number	Cm.	Number	Cm.	Number	Cm.
1-10 January	-	-	-	-	-	-	-	-	-	-	-	-	24	15.3	24	13.3
11-20 "	-	-	-	-	-	-	-	-	-	-	-	-	40	17.2	58	16.3
21-31 "	-	-	-	-	36	18.2	56	18.9	-	-	-	-	76	20.3	89	18.9
1-10 February	12	22.9	7	26.4	144	23.4	134	21.8	-	-	-	-	75	25.1	81	24.2
11-20 "	23	27.8	28	26.6	89	26.9	85	25.8	-	-	-	-	27	26.9	39	26.9
21-28 (29) "	43	30.3	35	28.3	61	29.8	64	27.7	-	-	-	-	18	29.9	12	30.8
1-10 March	52	34.2	44	32.9	17	32.7	23	32.0	14	35.1	17	34.5	10	33.9	9	33.2
11-20 "	58	36.6	60	33.5	34	36.5	43	35.4	15	38.9	25	37.2	10	38.2	15	35.5
21-31 "	46	39.5	42	37.9	17	39.0	22	37.4	22	42.3	16	40.4	23	41.4	18	39.6
1-10 April	4	43.0	4	40.7	74	43.5	71	41.1	-	-	5	43.8	5	41.8	3	43.0
11-20 "	25	46.7	30	44.6	36	47.0	29	46.1	17	47.9	19	45.8	52	46.5	46	43.6
21-30 "	25	49.6	26	48.0	18	49.1	23	47.1	76	49.0	93	46.8	28	48.2	26	46.2
1-10 May	35	54.1	45	52.2	-	-	-	-	60	51.6	59	49.6	-	-	-	-
11-20 "	56	54.4	37	53.0	-	-	-	-	43	53.3	51	51.6	-	-	-	-
21-31 "	81	58.0	65	53.8	-	-	-	-	44	56.9	64	53.2	-	-	-	-
1-10 June	13	58.7	18	57.6	-	-	-	-	17	60.4	10	58.2	-	-	-	-
11-20 "	33	59.6	26	57.4	-	-	-	-	11	60.0	22	59.3	-	-	-	-
21-30 "	-	-	-	-	-	-	-	-	48	59.9	42	56.8	-	-	-	-
1-10 July	-	-	-	-	-	-	-	-	10	63.1	14	59.1	-	-	-	-
11-20 "	-	-	-	-	-	-	-	-	9	64.1	2	66.0	-	-	-	-
21-31 "	-	-	-	-	-	-	-	-	2	63.0	1	59.0	-	-	-	-
1-10 August	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11-20 "	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1-10 December	-	-	-	-	-	-	-	-	[1] 2	[2] 4.0	-	-	-	-	-	-
Total	506		467		526		550		490		440		488		420	
Grand total	973				1,076				930				808			

[1962, 1963, 1958-63 combined]

Period	1962				1963				Combined			
	Male		Female		Male		Female		Male		Female	
	Fetuses	Mean length	Fetuses	Mean length	Fetuses	Mean length	Fetuses	Mean length	Fetuses	Mean length	Fetuses	Mean length
	Number	Cm.	Number	Cm.	Number	Cm.	Number	Cm.	Number	Cm.	Number	Cm.
1-10 January	-	-	-	-	-	-	-	-	24	15.3	24	13.3
11-20 "	-	-	-	-	-	-	-	-	40	17.2	58	16.3
21-31 "	-	-	-	-	-	-	-	-	112	19.6	145	18.9
1-10 February	-	-	-	-	-	-	-	-	231	23.9	222	22.8
11-20 "	-	-	-	-	-	-	-	-	139	27.0	152	26.2
21-28 (29) "	-	-	-	-	-	-	-	-	122	30.3	111	28.2
1-10 March	-	-	-	-	-	-	-	-	93	34.0	93	33.0
11-20 "	-	-	-	-	-	-	-	-	117	37.0	143	34.9
21-31 "	-	-	-	-	-	-	-	-	108	40.4	98	38.5
1-10 April	-	-	-	-	-	-	-	-	83	43.4	83	39.9
11-20 "	-	-	-	-	-	-	-	-	140	46.9	124	44.8
21-30 "	-	-	-	-	-	-	-	-	147	48.0	168	46.9
1-10 May	1	59.0	1	54.5	-	-	-	-	96	52.6	105	50.8
11-20 "	2	56.0	2	54.0	-	-	-	-	101	56.0	90	52.2
21-31 "	5	60.3	4	58.2	-	-	-	-	130	57.7	133	53.6
1-10 June	11	61.4	10	58.2	-	-	-	-	41	60.1	38	57.9
11-20 "	58	60.8	88	57.6	-	-	-	-	102	60.4	136	57.8
21-30 "	17	63.4	20	60.1	-	-	-	-	65	60.8	62	57.9
1-10 July	21	64.2	17	60.8	21	62.9	24	61.4	54	63.5	55	60.6
11-20 "	9	61.7	15	60.5	13	64.2	6	64.0	31	63.4	23	61.6
21-31 "	1	63.0	-	-	1	62.0	-	-	4	62.8	1	59.0
1-10 August	-	-	-	-	-	-	-	-	-	-	-	-
11-20 "	-	-	1	54.0	-	-	-	-	-	-	1	54.0
1-10 December	-	-	-	-	-	-	-	-	2	4.0	-	-
Total	127		158		35		30		1,972		2,065	
Grand total	285				65				4,037			

[1] Taken in 1961 pelagic season starting in 1960.
[2] Crown rump measurement.

Appendix table 16.--Mean weights of fur seal fetuses collected by U.S. research vessels in eastern Pacific, 1958-63

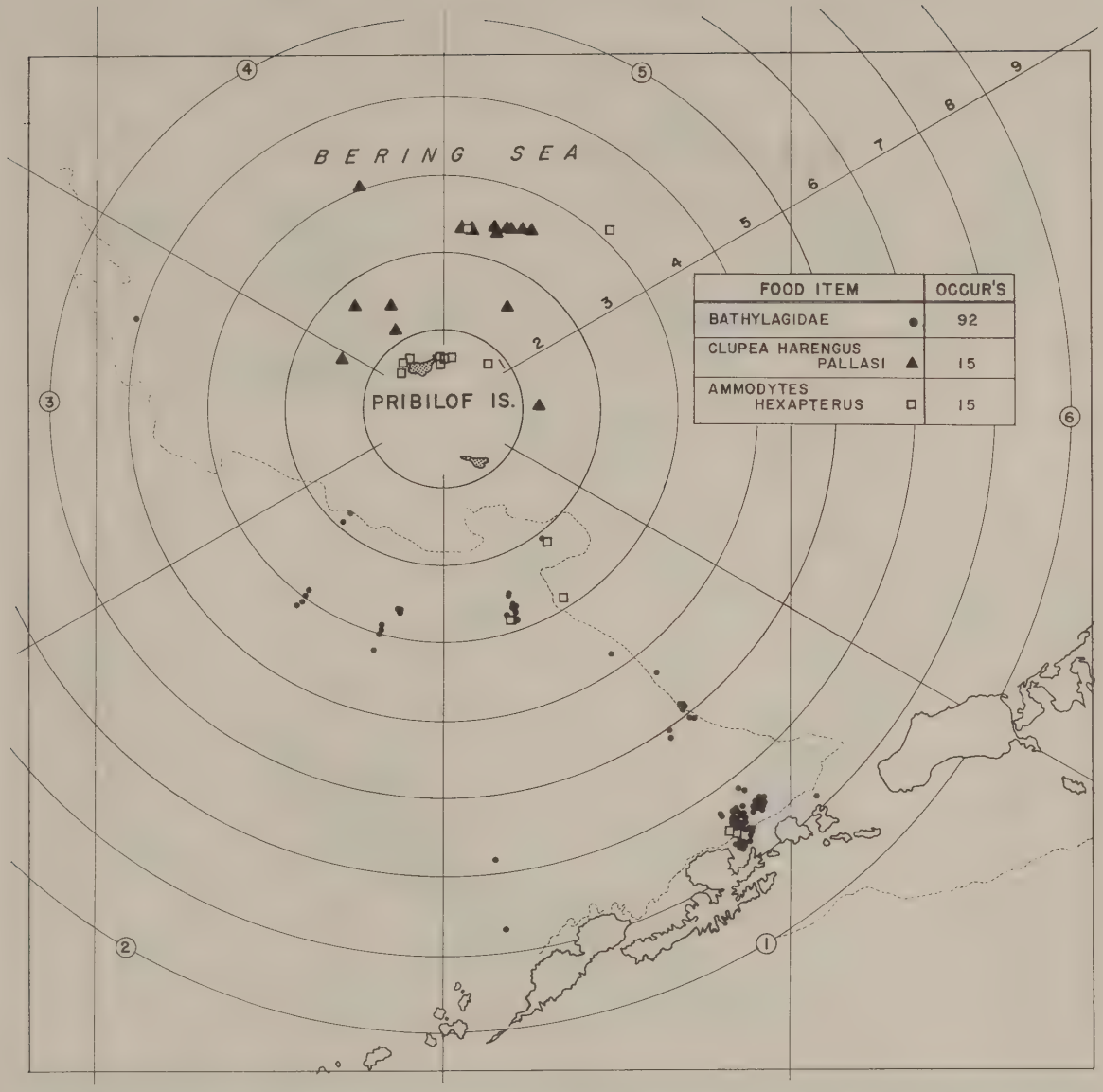
[1958-61]

Period	1958				1959				1960				1961			
	Male		Female		Male		Female		Male		Female		Male		Female	
	Fetuses	Mean weight	Fetuses	Mean weight	Fetuses	Mean weight	Fetuses	Mean weight	Fetuses	Mean weight	Fetuses	Mean weight	Fetuses	Mean weight	Fetuses	Mean weight
	Number	Kg.	Number	Kg.	Number	Kg.	Number	Kg.	Number	Kg.	Number	Kg.	Number	Kg.	Number	Kg.
1-10 January	-	-	-	-	-	-	-	-	-	-	-	-	24	0.2	24	0.1
11-20 "	-	-	-	-	-	-	-	-	-	-	-	-	41	0.2	58	0.1
21-31 "	-	-	-	-	36	0.2	56	0.2	-	-	-	-	75	0.3	89	0.2
1-10 February	14	0.4	7	0.4	144	0.4	133	0.3	-	-	-	-	74	0.5	82	0.4
11-20 "	24	0.5	30	0.4	89	0.6	85	0.5	-	-	-	-	27	0.6	39	0.6
21-28 (29) "	43	0.7	37	0.5	61	0.7	63	0.6	-	-	-	-	18	0.8	12	0.8
1-10 March	53	1.1	45	0.9	17	0.9	23	0.9	14	1.2	17	1.1	10	1.0	9	0.9
11-20 "	59	1.3	62	1.1	35	1.2	42	1.1	15	1.6	25	1.4	10	1.3	15	1.1
21-31 "	46	1.5	42	1.3	17	1.4	22	1.2	22	1.8	15	1.6	23	1.7	19	1.5
1-10 April	4	2.2	4	1.6	74	1.9	71	1.6	2	2.4	5	2.0	5	1.9	3	1.7
11-20 "	26	2.4	30	2.0	36	2.3	29	2.2	15	2.9	19	2.4	52	2.5	46	2.1
21-30 "	25	2.9	26	2.5	18	2.6	23	2.3	76	3.1	93	2.7	28	2.7	26	2.3
1-10 May	35	3.9	44	3.4	-	-	-	-	60	3.6	59	3.2	-	-	-	-
11-20 "	56	4.1	37	3.6	-	-	-	-	43	4.0	51	3.5	-	-	-	-
21-31 "	81	4.8	67	4.4	-	-	-	-	44	4.5	64	3.9	-	-	-	-
1-10 June	13	5.3	18	4.8	-	-	-	-	17	5.0	10	4.4	-	-	-	-
11-20 "	34	5.9	26	5.3	-	-	-	-	11	4.9	22	4.9	-	-	-	-
21-30 "	-	-	-	-	-	-	-	-	48	5.7	42	5.1	-	-	-	-
1-10 July	-	-	-	-	-	-	-	-	10	5.9	14	5.1	-	-	-	-
11-20 "	-	-	-	-	-	-	-	-	9	6.2	2	5.8	-	-	-	-
21-31 "	-	-	-	-	-	-	-	-	2	6.0	1	5.3	-	-	-	-
1-10 August	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11-20 "	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1-10 December	-	-	-	-	-	-	-	-	[1] 2	0.003	-	-	-	-	-	-
Total	513		475		527		547		390		439		387		422	
Grand total	988				1,074				829				809			

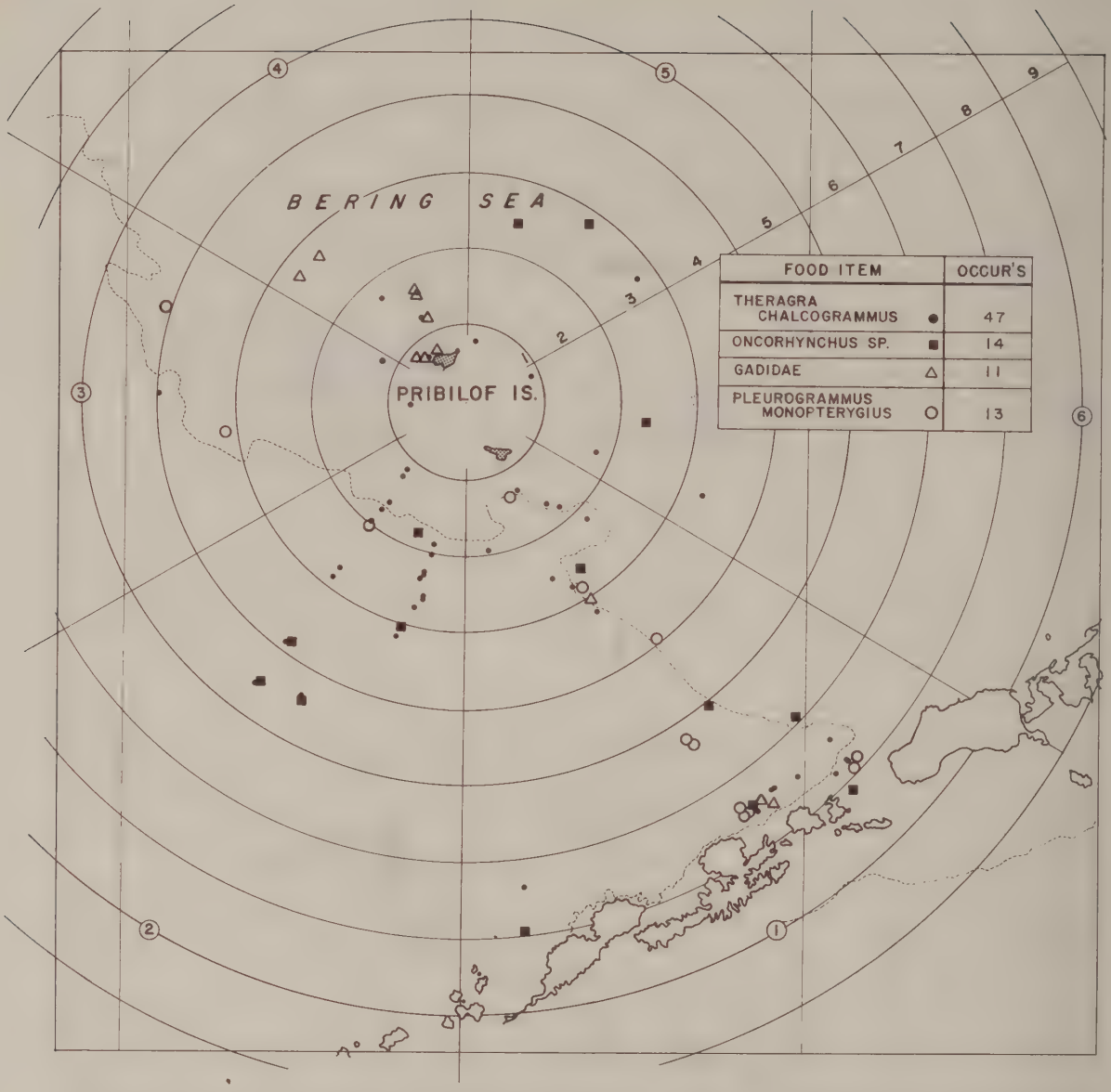
[1962, 1963, 1958-63 combined]

Period	1962				1963				Combined			
	Male		Female		Male		Female		Male		Female	
	Fetuses	Mean weight	Fetuses	Mean weight	Fetuses	Mean weight	Fetuses	Mean weight	Fetuses	Mean weight	Fetuses	Mean weight
	Number	Kg.	Number	Kg.	Number	Kg.	Number	Kg.	Number	Kg.	Number	Kg.
1-10 January	-	-	-	-	-	-	-	-	24	0.2	24	0.1
11-20 "	-	-	-	-	-	-	-	-	41	0.2	58	0.1
21-31 "	-	-	-	-	-	-	-	-	111	0.3	145	0.2
1-10 February	-	-	-	-	-	-	-	-	232	0.4	222	0.3
11-20 "	-	-	-	-	-	-	-	-	140	0.6	154	0.4
21-28 (29) "	-	-	-	-	-	-	-	-	122	0.7	112	0.6
1-10 March	-	-	-	-	-	-	-	-	94	1.1	94	0.9
11-20 "	-	-	-	-	-	-	-	-	119	1.3	144	1.2
21-31 "	-	-	-	-	-	-	-	-	108	1.6	98	1.4
1-10 April	-	-	-	-	-	-	-	-	85	1.9	83	1.6
11-20 "	-	-	-	-	-	-	-	-	129	2.5	124	2.1
21-30 "	-	-	-	-	-	-	-	-	147	2.9	168	2.6
1-10 May	1	5.1	1	3.4	-	-	-	-	96	3.7	104	3.3
11-20 "	2	4.1	2	3.4	-	-	-	-	101	4.1	90	3.5
21-31 "	5	4.7	4	4.1	-	-	-	-	130	4.7	135	4.2
1-10 June	11	5.2	10	4.4	-	-	-	-	41	5.2	38	4.6
11-20 "	58	5.6	88	5.0	-	-	-	-	103	5.6	136	5.0
21-30 "	17	6.0	20	5.5	-	-	-	-	65	5.8	62	5.2
1-10 July	23	6.4	17	5.7	20	5.8	24	5.2	53	6.1	55	5.3
11-20 "	9	6.2	15	5.8	13	6.4	6	5.5	31	6.3	23	5.7
21-31 "	1	5.6	-	-	1	7.6	-	-	4	6.3	1	5.3
1-10 August	-	-	-	-	-	-	-	-	-	-	-	-
11-20 "	-	-	1	5.3	-	-	-	-	-	-	1	5.3
1-10 December	-	-	-	-	-	-	-	-	2	0.003	-	-
Total	127		158		34		30		1,978		2,071	
Grand total	285				64				4,049			

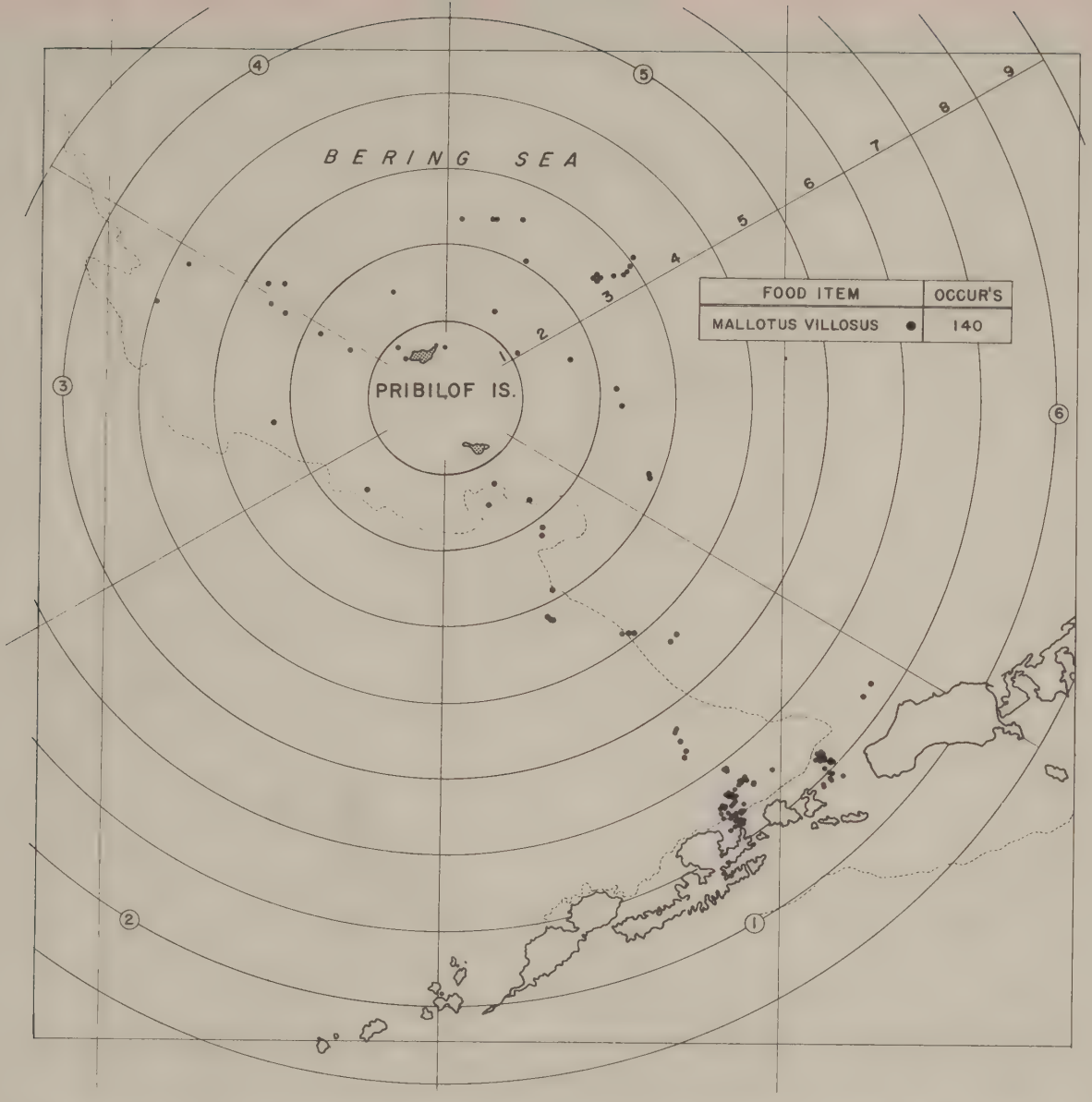
[1] Collected in 1961 pelagic season starting in 1960.



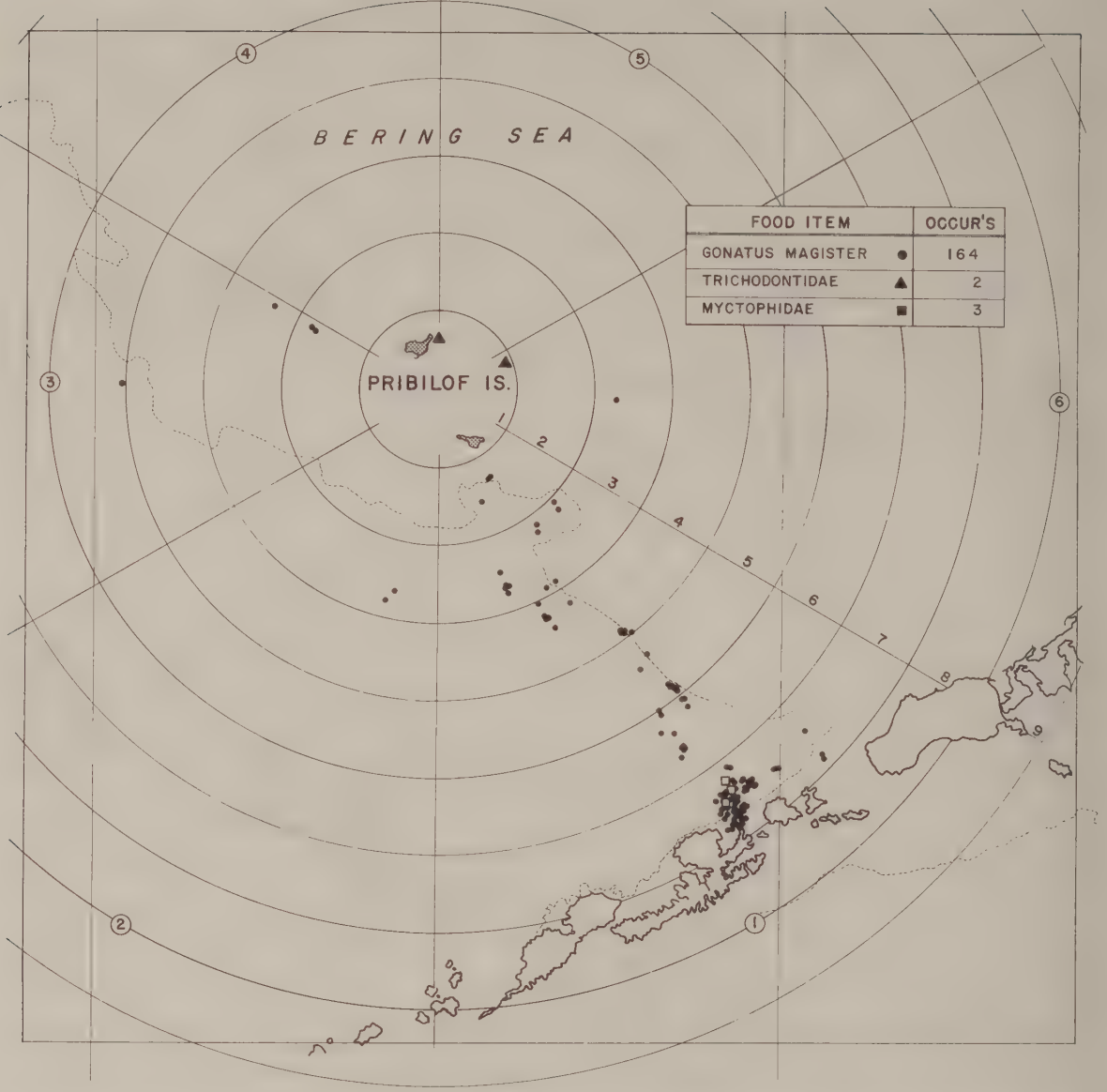
Appendix figure 1.--Locations where fur seal stomachs collected in 1963 contained Clupea harengus pallasi, Bathylagidae, and Ammodytes hexapterus. The 100-fathom depth curve is shown as a dotted line.



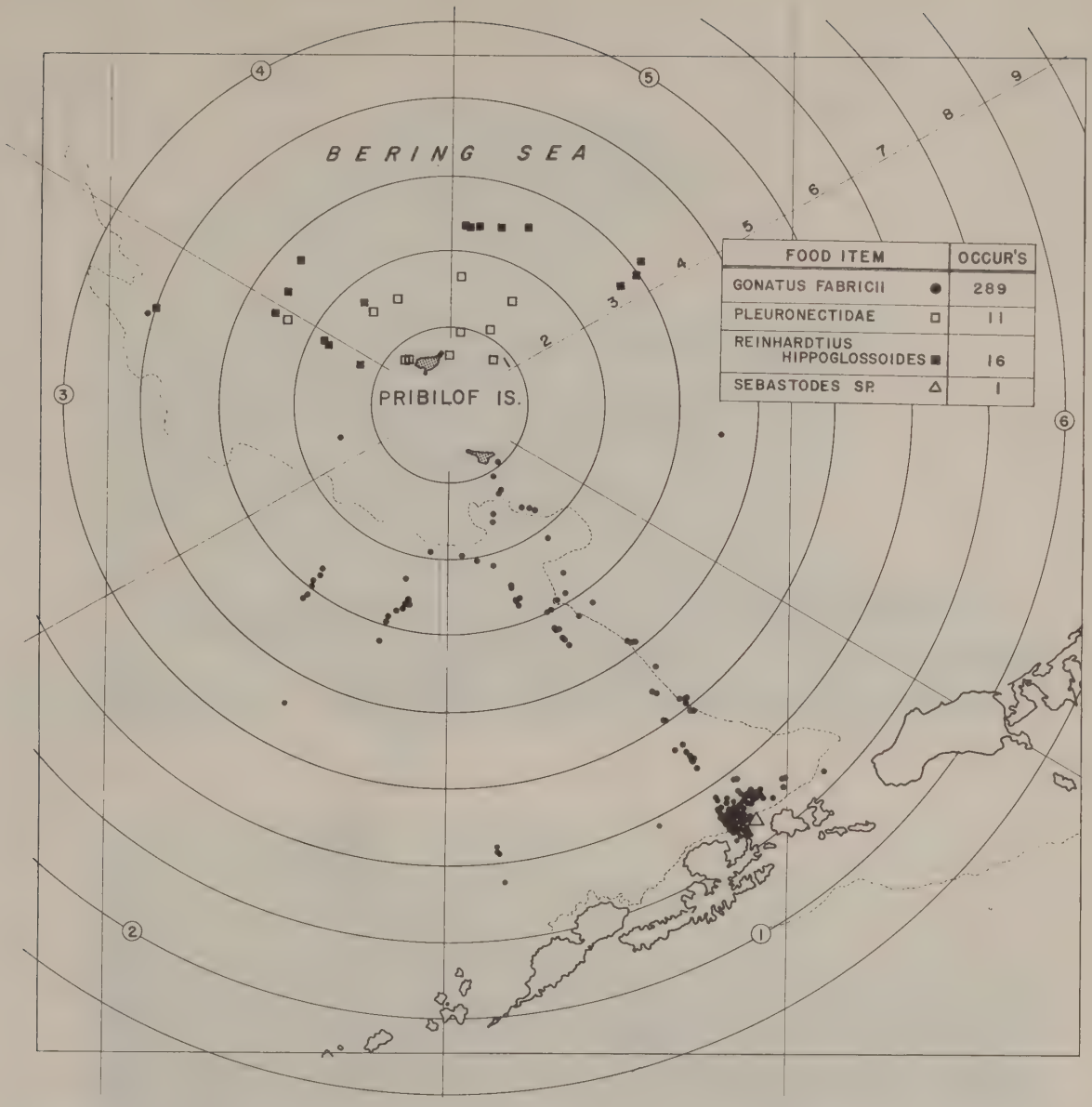
Appendix figure 2.--Locations where fur seal stomachs collected in 1963 contained Oncorhynchus sp., Theragra chalcogrammus, Gadidae, and Pleurogrammus monopterygius. The 100-fathom depth curve is shown as a dotted line.



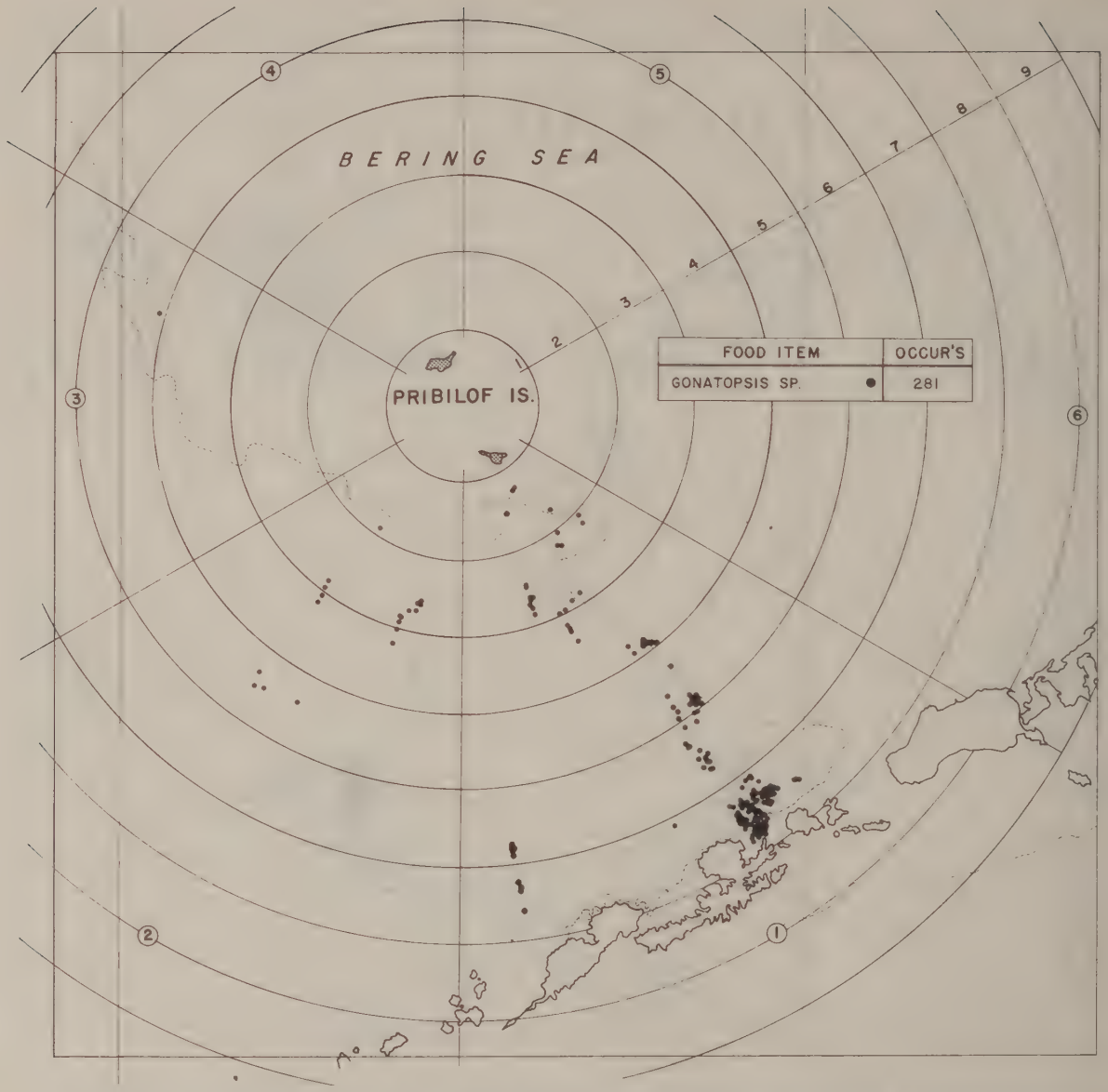
Appendix figure 3.--Locations where fur seal stomachs collected in 1963 contained Mallotus villosus. The 100-fathom depth curve is shown as a dotted line.



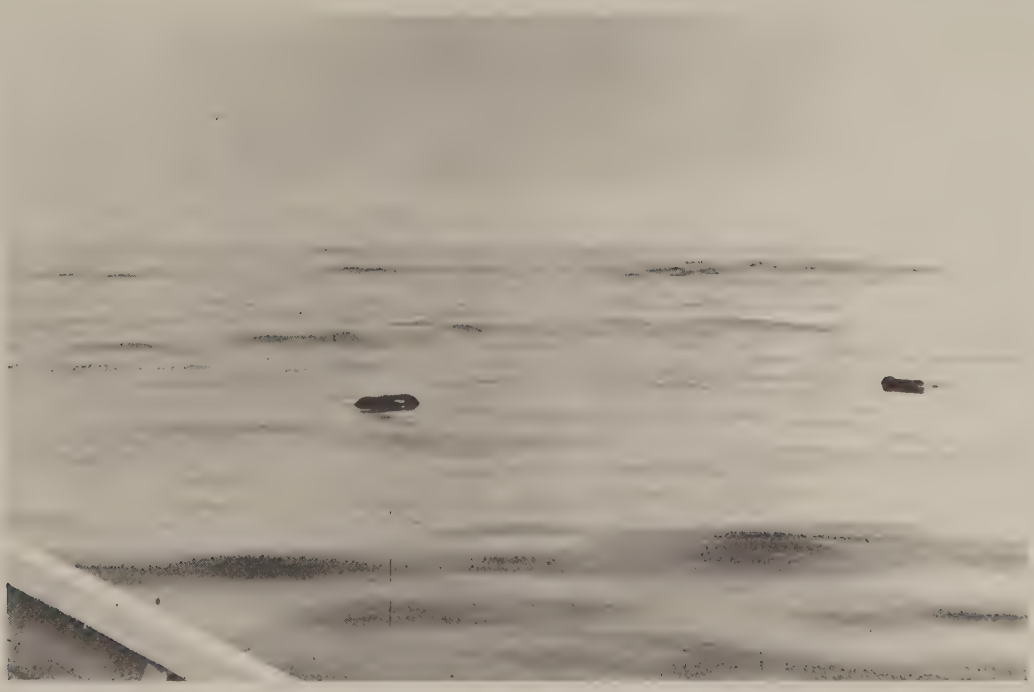
Appendix figure 4.--Locations where fur seal stomachs collected in 1963 contained Myctophidae, Trichodontidae, and Gonatus magister. The 100-fathom depth curve is shown as a dotted line.



Appendix figure 5.--Locations where fur seal stomachs collected in 1963 contained Sebastodes sp., Pleuronectidae, Reinhardtius hippoglossoides, and Gonatus fabricii. The 100-fathom depth curve is shown as a dotted line.



Appendix figure 6.--Locations where fur seal stomachs collected in 1963 contained Gonatopsis sp. The 100-fathom depth curve is shown as a dotted line.



Appendix figure 7.--On calm days sleeping fur seals can be plainly seen for a considerable distance. With flippers folded they look like a drifting piece of dark wood.

Appendix figure 8.--When moving rapidly seals often leap out of the water. This behavior is most typical of young animals and is unusual for mature bulls or females in late pregnancy.

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